IN THIS ISSUE:

AN ALTERNATIVE TO EINSTEIN
NEW SOURCES OF PULP AND PAPER

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

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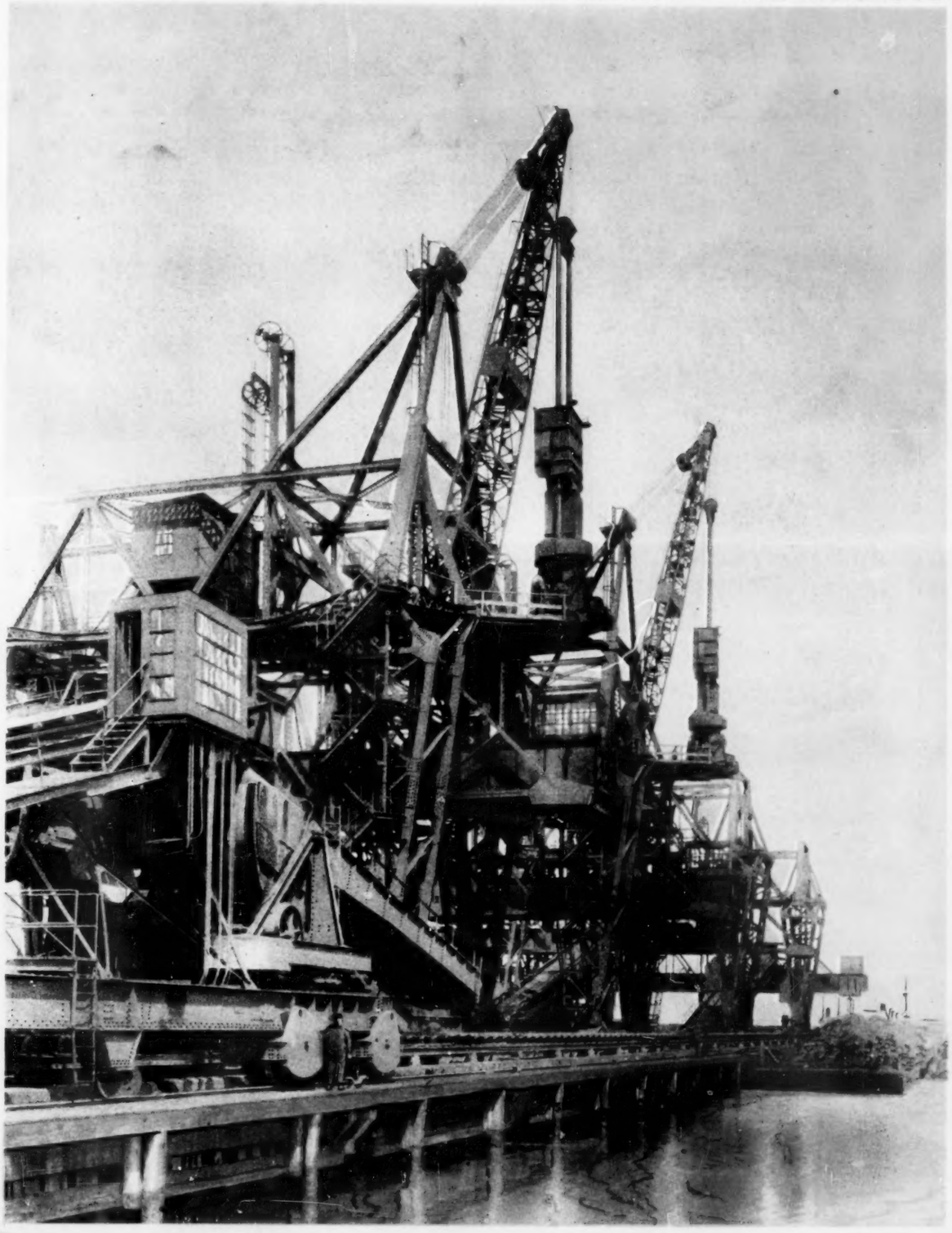

NEW COAL PIER AT CURTIS BAY, BALTIMORE, WHICH HANDLES SIXTY TONS PER MINUTE.—[See page 470]

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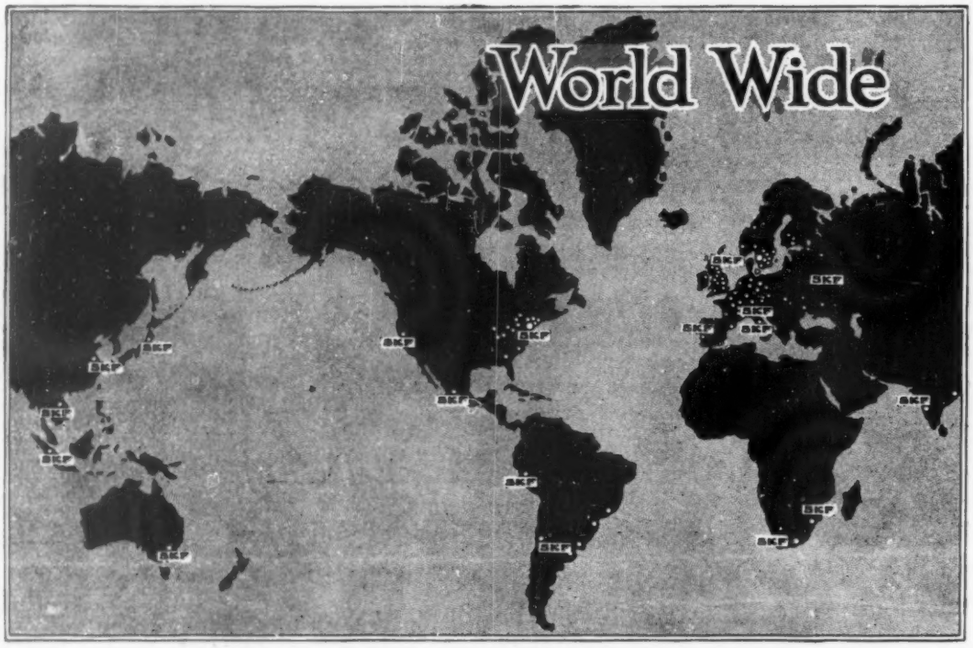

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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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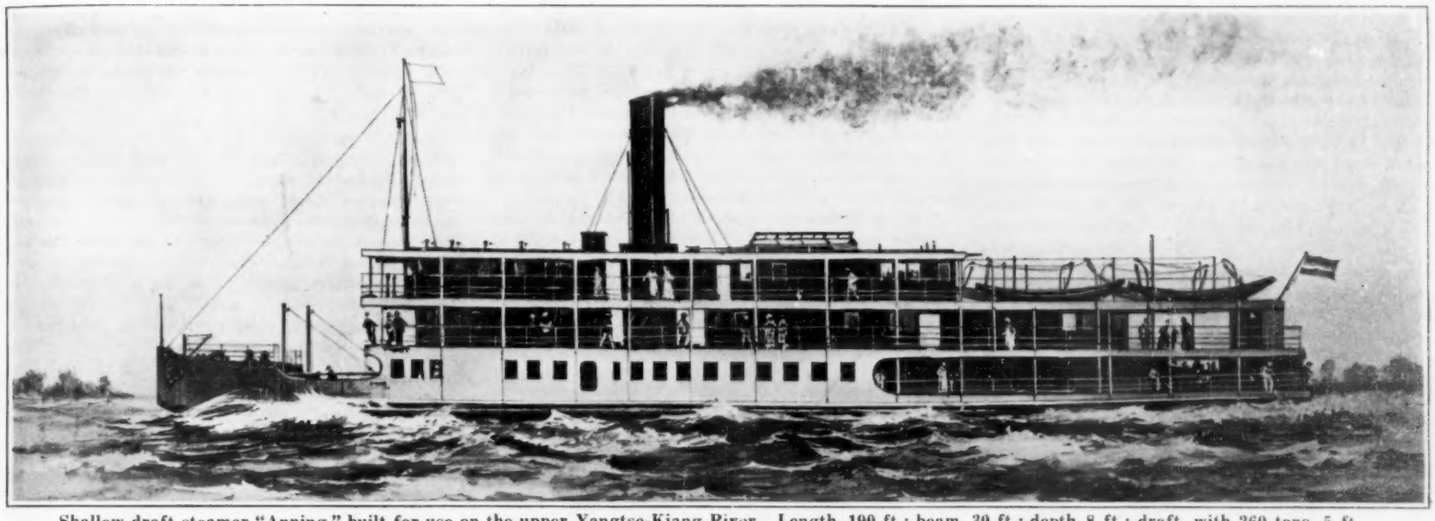

Shallow-draft steamer "Anning," built for use on the upper Yangtse-Kiang River. Length, 190 ft.; beam, 30 ft.; depth, 8 ft.; draft, with 260 tons, 5 ft. Speed, 15 miles per hour

The Yangtse Shallow-Draft Steamer "Anning"

THE Yangtse-Kiang in addition to being one of the longest rivers in the world is remarkable in being the only artery connecting the province of Szechuan with the outer world, except for foot trails which in places pass through difficult country and over high mountains. The province of Szechuan, known in Chinese history as "Nature's Treasure House," has an estimated population of about 60 to 70 million people, so that the provision of an adequate steamship service on this river is of very great importance.

On the lower reaches ordinary steamers of considerable size can navigate as far as Ichang, a distance of about 1,100 miles from the mouth. Above Ichang, however, the conditions are considerably changed, the river between that town and Chungking passing through rugged mountain defiles, where the depth of water ranges from 6 to 60 fathoms at the low level of winter.

The rapids, whirlpools, "boils," "freshets" and other phenomena peculiar to this river, combined with local fogs and shifting shoals, render navigation more difficult than in almost any other part of the world, and call for a vessel having shallow draft, propelling machinery of abnormally high power, good steering capabilities, reliability and special arrangements for warping or hauling over a rapid.

In 1913 the "Shu-Hun" was constructed by Messrs. Yarrow & Co. for the Szechuan Steam Navigation Company to ply between Ichang and Chungking. The great success of this vessel has resulted in the ordering of a number of vessels of the same type. One of these, the "Anning," has recently been completed by the same firm and shipped in pieces. A short description of this vessel will be of interest:

The "Anning" is an almost exact repeat of the "Shu-hun" but embodies several improvements which have been introduced since that vessel was built. Her length overall is 190 feet, beam 30 feet and the depth molded to main deck 8 feet. The hull is divided into nineteen compartments by transverse and longitudinal bulkheads, and watertight doors are fitted to the bunker bulkheads. There are four decks: the main deck, upper deck, boat deck and awning deck.

The accommodation for European and first-class Chinese passengers is on the boat deck. On the upper deck are accommodated the officers and second-class Chinese passengers.

On the main deck there is accommodation for 206 Chinese steerage passengers, 15 firemen and 3 Chinese engineers, and in the forecastle there is accommodation for 4 petty officers and 12 men, and there is also a mess place for 14 cooks and boys.

The vessel is lighted throughout by electric light. There are 5 separate holds for cargo having a total capacity of 16,000 cubic feet, which corresponds with a deadweight capacity of about 260 tons at 5 feet draft.

There is a special double-headed steam capstan forward, one head being arranged for working the anchors and for ordinary warping purposes, the other being specially designed for warping up the rapids at such times as these may be too strong for the steamer to navigate under her own power. Large rollers are fitted on the berthing for bringing in the warp. Strong bollards and fairleads are arranged both forward and aft.

The main propelling machinery consists of two sets of triple expansion surface condensing engines capable of developing about 2,000 indicated horsepower. The boilers are two in number of the company's double-ended water-tube type.

The propellers are of large diameter suitably designed for transmitting the large power which the engines develop. They work in tunnels fitted at the after end with the Yarrow automatic flap, whose operation is as follows:

Referring to the line drawings, in Fig. 1 is shown the ordinary screw tunnel vessel. By means of the tunnel a larger propeller can be fitted than the draft of water admits, an obvious advantage where the draft of a vessel is limited. When the boat is at rest the upper part of the tunnel above the water line is filled with air; immediately the propeller commences to revolve the air is driven out of the tunnel and replaced by water so that the propeller works efficiently on a solid column of water. It will be seen that if the draft of the vessel is increased by loading more heavily, the fixed sloping part of the tunnel shown in Fig. 1 would extend at the after end considerably below the water line and act as a drag, reducing the efficiency of propulsion. The details of the new system are shown in Fig. 2, the after end of the tunnel being sealed by

(Continued on page 477)

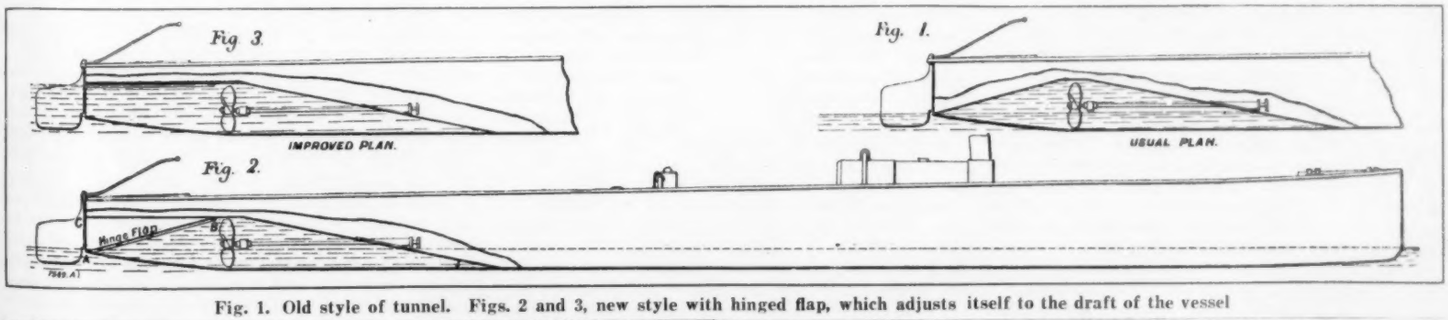

Fig. 1. Old style of tunnel. Figs. 2 and 3, new style with hinged flap, which adjusts itself to the draft of the vessel

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Aerial Radio Protection

IF the shocking airplane disaster near Morgantown, Maryland, on Decoration Day results in the establishment of a governmental radio service for the protection of fliers throughout the country, the seven victims of the disaster will not have died in vain. In all probability the fatal crash is to be attributed not to the pilot or to the machine, but to the weather. The pilot was an experienced and able man, the machine was very stable—a point on which the writer is entitled to speak, having made a trip in the "Eagle" during which his most predominant impression was of its great stability. Furthermore, the fact that the machine was to carry some distinguished passengers renders it certain that, for this trip it had been thoroughly overhauled and inspected by Army mechanics. At the present writing it seems fairly certain that the pilot, because of the thunderstorm, was making a landing, when he was caught in some down-rushing body of air that dashed the machine, nose first, to the ground while it was one or two hundred feet above the earth. Had the machine been 1,000 or 1,500 feet up, it would have been possible for the pilot, even in those disturbed conditions, to have righted the machine and flown it out of the area covered by the electrical storm.

It has been suggested that the machine was caught on the forward crest of what might be called a wave billow or breaker, and borne to earth just as a fisherman's skiff is thrown down and crashed upon the beach by a breaking billow in a great sea storm. This is altogether possible. Something of this effect may be seen, occasionally, in an advancing electrical storm-cloud, when the black masses of vapor curl over and are hurled violently downward, very much in the fashion of a big wave breaking above a bar or upon a sloping shore. Under such conditions the elevators and ailerons are rendered impotent; and, should the machine be flying with the storm, she would be caught and rolled over, nose first, in the fashion described by a man who witnessed the recent disaster.

The obvious moral of this tragedy is that aircraft, big or little, should never go up when storms are locally imminent, or traverse aerial routes on which the atmospheric conditions are threatening. Obviously, the only way to obtain such security is to provide for the wide and hourly dissemination to air stations throughout the country of full meteorological data.

The National Advisory Committee for Aeronautics has recommended the establishment of a bureau of aeronautics in the Department of Commerce. Whatever division of opinion there may be as to the reorganization of the Army and Navy into one united Air Service, there can be no two opinions as to the advisability of forming a Government Bureau of this or similar character, whose duty it shall be to furnish all aviators and all the landing grounds with full information as to meteorological conditions that affect aerial travel. This data could be dispatched by radio or telephone. This movement should secure unanimous and speedy action on the part of Congress.

War by Annihilation

"MR. CHAIRMAN, the Chemical Warfare Service has discovered a liquid approximately three drops of which, when applied to any part of the skin, will cause a man's death. Much smaller amounts than this, or even vapors from the liquid, cause very severe, slow-healing burns."

If the reader applies to the Government Printing Office at Washington, he can get therefrom a copy of the Hearings at the Third Session of the House Naval Affairs Committee, and he will find there that the words above quoted form part of a statement by Mr. Bradner, Chief of Research of the Chemical Warfare Service. Mr. Bradner goes on to remind the Committee that the World War showed it to be possible for an airplane to fly within a hundred feet of enemy troops and machine-gun them with immunity; and he goes on to state that if, instead of carrying machine guns, the attacking planes were equipped to carry a tank of this liquid (Lewisite) for discharge from nozzles similar to the ordinary street sprinkler, it would fall like rain, killing everything in its path.

Then he becomes more specific and tells us that one plane, carrying two tons of the liquid, could cover a stretch of country 100 feet wide by seven miles long in one trip, and that it could spray down enough of the liquid gas to kill every man in that area simply by the action of the gas upon the skin. Then, a little later, he becomes even more specific and tells us that, during the Argonne offensive, the entire First American Army of a million and a quarter men occupied an area of approximately 40 kilometers long by 20 kilometers wide. If, he goes on to say, Germany had possessed 4,000 tons of this material and, say, 350 planes properly equipped for spraying, our entire First Army would have been annihilated in from ten to twelve hours.

Now, 4,000 tons seems like a big lot of gas; but we already possess at the Aberdeen Proving Ground a huge poison-gas factory (Edgewood) which was capable, at the armistice, of producing 200 tons of gas per day, and it would be a simple matter by enlargement and duplication to put this country in a position where it could produce several thousand tons of gas for the supply of our armies, and keep the supply going indefinitely. Yes, the future war will be so horrible as to make the late war restful by comparison. Short as it will inevitably be, it will last long enough to wipe out mankind at a rate which will turn many a flourishing capital into a deserted village, and many a fair campagna into a Sahara of lifeless desolation—for this gas, remember, is as fatal to vegetation as to human life.

All this talk, however, about the poison-gas war of the future is based on what we dare to believe is an altogether unwarrantable assumption, namely, that the devil's own disregard of the humanitarian laws of war, initiated by the Germans at Ypres, is to be accepted and practised by the world at large. If, in the forthcoming meetings on disarmament, or of the suggested "Association of Nations," or the League, or what-not, it be accepted that poison gas warfare is lawful, we dare to believe that this sanction will be given in the face of the protest of that undoubtedly large majority of men, who believe that honor, chivalry and human kindness are not quite dead in our midst, and that the monstrous horror of the first gas attack at Ypres should not be the yardstick by which we measure our future military conduct.

It has been urged that the free use of gas will make future wars so frightful that no nation will dare to provoke a conflict. The answer to that assumption is that, in the past, the development of new weapons of great destructive power has never prevented a nation from rushing into war.

The Price of Fame

AMERICAN enterprise has always been a source of pride to Americans; and nowhere is it better exemplified than in American newspaperdom. The lengths to which the gatherers of the daily news will go to secure or to avoid a "beat" are proverbial. If these methods were applied with discrimination, all would be well; but they are not applied with discrimination. The same general rough and ready procedure is employed in getting inside the police lines to cover a big fire or a big crime, and in seeking an interview with the celebrity of the current hour. When this celebrity happens to be a principal in a sensational case, this is all very well. But there are those who are in the public eye in a different capacity, who ought to have some rights in the presence of the reporter and the camera man, yet to whom such rights are ruthlessly denied.

A case in point is that of Mme. Curie. Her visit to America to receive her gift of radium might have been an unalloyed pleasure and a much-needed holiday. Instead of this it has been made, largely through the efforts of the American press, a continuous nightmare. A distinguished guest must expect to be met on arrival in America by a delegation of newspaper men, and may be supposed to have prepared for this meeting. A coming-off party at the dock, prefaced by such preparation, would be to any reasonable visitor a pleasure rather than a pain. But the visitor will learn, before he has been twenty-four hours on our soil, that this is but a taste of what is to come. He will find his hotel crowded at all hours, day and night, with picture-takers and interview-seekers who never sleep—or who are replaced by others as fast as they succumb to fatigue. Go where he will, do what he can, he is dogged by these pests, for whom the most emphatic "No" is merely the signal for renewed attack.

The program mapped out for the discoverer of radium was itself a severe one, involving much traveling about in a hurry, much public appearance, much formal entertainment. This was part of the program. But we have no doubt that the good lady supposed that after her first reception on landing, the demands of our press would be satisfied by her appearances in public, with an occasional prepared statement for the entire press. Instead of this, she is literally besieged in every stopping place by an army of special writers, who want pictures, pictures, pictures, and interviews, interviews, interviews, on every subject under the sun, —those on which Mme. Curie is no authority as well as those on which she is. This, be it understood, is "human interest stuff." And it goes without saying that every applicant must have nothing less than a special, exclusive and personal encounter with the great lady, with full permission to ask any question and any number of questions desired. The result of this is, with not the slightest exaggeration, that Mme. Curie has been hounded to an extent that has imperiled her health, made it necessary for her to keep the strictest seclusion, and forced her to arrange for an immediate sailing on emergence.

Professor Einstein has had much the same experience. He came to this country in the interests of Zion. He must have realized that it is only through relativity that his name and support are of value, so he must have expected to talk about relativity as well as about Zion. But where in the case of Mme. Curie every subject under the sun was set out, Einstein found it impossible to speak through the newspapers on anything but relativity. After talking for hours to the newspaper men, everything he said about Zion was ruthlessly suppressed, every chance word which his artful interviewers could wring out of him on relativity was strung out into a paragraph. And everything he was represented as saying is said better in his book! This single experience was enough for Einstein; after it he met no reporters, and his only contact with the press was through prepared statements—a program made possible by the large and efficient organization in whose hands he was. Our good friend Dr. Adams of Princeton was not so fortunate; the week which Einstein spent at New Jersey's seat of learning he spent in the woods on his horse, eluding the reportorial hordes who sought to get out of him what they couldn't get out of Einstein.

Our own attention has been attracted to this situation, we may as well confess, through our having been made the vicarious receptacle for the wrath and disgust of the two distinguished foreigners. We couldn't get an interview with Einstein because we didn't go out to meet him in an airplane, but waited until he had got decently settled in this country—and incidentally until he had had his fill of American interviewers. We couldn't get an interview with Mme. Curie because we tried to be similarly considerate; because we waited until our enterprising contemporaries had got her views on woman's suffrage, and the League of Nations, and prohibition, and the place of woman in the home, and had worn her down to a point where it was a physical impossibility for her to be seen. We shall know better how to conduct such business when next a foreign scientist of note sails for our shores. In the meantime, is it too much to hope that our newspapers will make it possible for the next celebrity from abroad to take home a pleasant impression of the United States; and that in time they will even go so far as to draw a reasonable line between what is news and what is not?

Automobile

Motor Car Business Poor in France.—According to the present outlook, motor car manufacturers in France will have little business until trade generally is on its way toward recovery. Meanwhile firms are finding it difficult to tide over the crisis. Some are drifting into new fields; one is making machinery for contractors and marine work, another is hoping to secure a government order for gasoline locomotives.

Preserving Rubber Hose Connections.—The rubber hose connection between the radiator and the cylinder jacket outlet and the pump connections should be covered with shellac at intervals to keep them waterproof and also impervious to the oil and grease that are inevitable around an engine. Oil and grease have a tendency to disintegrate and rot the rubber, but shellac prevents these materials from working into the rubber.

Preventing Theft of Radiator Caps.—As an outcome of frequent thefts of motometers and radiator caps, an accessories manufacturing company is putting on the market a new cap that is locked in place by an eight tumbler lock with over one thousand key changes and no master key, precluding the possibility of professional thieves being provided with one or a set of keys to fit it. The action of the lock forces a hardened steel bolt into a slot in the adapter ring, which is secured to the radiator neck by three cup point set screws, seated from inside the ring. These screws are forced tightly into the inside of the neck by means of an "L" wrench furnished with the cap. The adapter fits all radiators with screw caps except a few with caps of abnormal size.

New Air Filter Has Self-Cleaning Features.—An air cleaner in which felt is used as a filtering medium has recently been placed on the market. The device consists of a cylindrical, perforated shell, into which is fitted an elongated spider formed of wire screen and covered with felt. The central portion of the spider communicates with a central tube, through which the clean air entering the carburetor flows. The felt-covered surface spider is said to have an area of over 500 square inches. The area of the inlet holes being large, the entering velocity of the air is low and consequently the larger particles of dust are allowed to settle out before the air passes through the felt. It is claimed that the air entering the cleaner does not strike directly upon the filtering material and that the dust which collects on the surface of the felt is shaken off by the vibration of the vehicle on which the cleaner is used. The dust shaken loose drops out of the shell through holes in the base.

Kerosene Not Always an Economical Fuel.—Despite its lower cost, kerosene is not a cheaper fuel than gasoline unless great care is taken in the design of the engine using it. In stationary gasoline-engine practice it has long been the rule to figure on a consumption of one gallon per 10-hour day per horsepower, which is equivalent to 10 horsepower-hours per gallon. Considerably better results are possible under specially favorable conditions. But in a trial of tractors at Lincoln, Neb., the average of sixty-five tractors tested was only 4.5 horsepower-hours per gallon. There is just as much energy in a gallon of kerosene as there is in a gallon of aviation gasoline; slightly more, in fact. That the fuel economy of tractors is only about 50 per cent that of fairly large stationary gasoline-engines is due chiefly to two causes: Low compression must be used with the kerosene to prevent knocking, and a good deal of the kerosene either passes through the engine unburned or else burns so late in the power stroke that practically none of the heat of combustion can be turned into useful work.

Metal Truck Bodies.—For some reason, metal construction has not made as much progress to date in connection with truck bodies as with passenger bodies, although the service conditions in truck work are much more severe. There has recently appeared on the market an all-metal truck body made in Kansas City, in the production of which the electric welding process plays an important part. The body is practically one piece, for the individual parts are welded together electrically. The longitudinal sills and cross sills are formed into a girder-like structure and provide a rigid bed to which the body itself is welded. This construction produces a body with a smooth interior, which is an advantage when hauling clay and similar materials, as there is then very little tendency for the load to adhere to the body when the latter is tilted. Another feature is the double acting tail-gate which can be opened either from the bottom or the top. When opened from the top the two cotter pins are removed with a minimum of time and effort, and the opening may then be regulated by the adjusting chain.

Astronomy

Changes in the Crab Nebula.—Dr. V. M. Slipher, of the Lowell Observatory, reports that changes in the structure of the Crab nebula in Taurus have been detected by Lampland on negatives taken with the 40-inch Lowell reflector. These observations are based on examinations of 15 photographs covering an interval of eight years.

Astronomical Postcards.—Picture postcards presenting charts or views of celestial objects are now issued by at least two publishers in Germany; viz., the Verlag für Technik und Wirtschaft, of Naumburg, and Henry Grand, of Hamburg-Altrahlstedt. In the latter case they include star maps for the twelve months of the year, views of the moon, and pictures of nebulæ and star clusters.

Sunspots in 1920.—The last maximum of sunspots was in 1917. During 1920 spottedness continued to decline, the mean daily spot-area for the year being about 700 millionths of the sun's visible hemisphere, or half of that of 1917. On a few occasions, especially during August, the solar disk was practically free from spots, while on some days in January and March the total spotted area was more than 2,500 millionths.

A Municipal Observatory.—The city of Des Moines has recently acquired a municipal astronomical observatory. The city council voted bonds for its erection and provided a site in a park, while Drake University agreed to equip the building with an 8¼-inch telescope and other apparatus and to take charge of and man the establishment. The observatory, which is admirable from an architectural standpoint, is open to the public at least two evenings a week and one afternoon.

Completion of the Hooker Telescope.—Dr. Hale's last annual report, as director of Mount Wilson Observatory, states that with the completion of the observing platforms at the principal and Cassegrainian foci and the installation of the constant-temperature control system for the 100-inch mirror, the great Hooker telescope—the largest in the world—is now essentially complete, though "work on its accessory instruments will be continued as long as new and promising devices are in view."

Proposed Publication of Star Charts.—The American Association of Variable Star Observers is planning to supply its members and others with sets of photographic reproductions of the charts of the Bonn Durchmusterung, provided enough subscribers can be obtained at $16 a set. The complete set will include 64 charts, approximately 8 by 10 inches in size. Further information on this subject and a sample chart can be obtained from Mr. D. B. Pickering, 171 South Burnett St., East Orange, N. J.

Lunar Zodiacal Light?—Dr. W. E. Glanville, of Solomons, Md., reports to the British Astronomical Association that on Feb. 21, 1916, he made a successful observation of the "moon's zodiacal light," reported by Jones and other observers. At the time of observation the gegenschein showed on the ecliptic. At 8:15 a distinct luminosity, fainter than the sun's zodiacal light but in the usual shape of the latter when near the horizon, was visible from the moonrise point (over Chesapeake Bay), reaching the southern boundary of Leo up to the gegenschein, which became commingled with the light. The luminosity persisted until moonrise at 8:40. Mr. Gavin Burns, director of the aurora and zodiacal light section of the B. A. A., remarks on this observation: "As the light of the full moon is only about one-millionth the intensity of sunlight, it is difficult to believe that the phenomenon described can be due to the light of the moon."

Minor Planets in 1920.—Thirty-nine minor planets were discovered in 1920, of which 16 were discovered by K. Reinmuth, of the Königstuhl Observatory, Heidelburg, and the rest by Dr. Baade, Hamburg; Messrs. Gonnessiat and Jekhowsky, Algiers; R. T. A. Innes, Johannesburg; Dr. Palisa, Vienna; Professor Schwassmann, Hamburg; Prof. Comas Sola, Barcelona; and Professor Wolf, Heidelburg. Planet 925, found by Comas Sola Jan. 13, 1920, has been named Alphonsina. It was of about the ninth magnitude and was extensively observed for four months. The object 1920 HZ, found by Baade Oct. 31, has an orbit of a cometary character. The perihelion is near the orbit of Mars and the aphelion near that of Saturn, while the inclination is very large. It shows no nebulous envelope on plates taken with an exposure of half an hour, so that it is difficult to apply the name "comet" to it. Planets 469 Argentina and 583 Clotilda, which had been missing for some years, were recovered in 1920. Planet 99 Dike gave evidence of variability of light. The Trojan planets Hector and Nestor were observed by Dr. Baade in March, 1920.

Aeronautics

A Parachute Record.—To Lieut. Arthur Hamilton of the U. S. Army, goes the record for parachute jumps, for he recently left an airplane at a height of 24,400 feet and drifted eight miles before touching the ground. He is said to have fallen asleep from cold during part of his descent.

The Schneider Giant is referred to in a recent issue of *L'Air* as a biplane of some 100 feet spread, which will weigh about eight tons. This French machine will be equipped with four 400-horsepower motors arranged in two tandem pairs. But the real feature of novelty is that this plane has been designed to carry a 3-inch cannon.

Advantages of Thick Wings.—During a visit to the Junker factory at Dessau, Professor Junkers, in demonstrating his method of obtaining wind tunnel results, drew attention, while discussing the experimental results of "thick" wing sections, to the fact that the employment of a thick section restricted very considerably the movement of the center of pressure. Statements by German "Junker" pilots to the effect that the "Junker" was exceptionally steady in bad weather would seem to corroborate this statement.

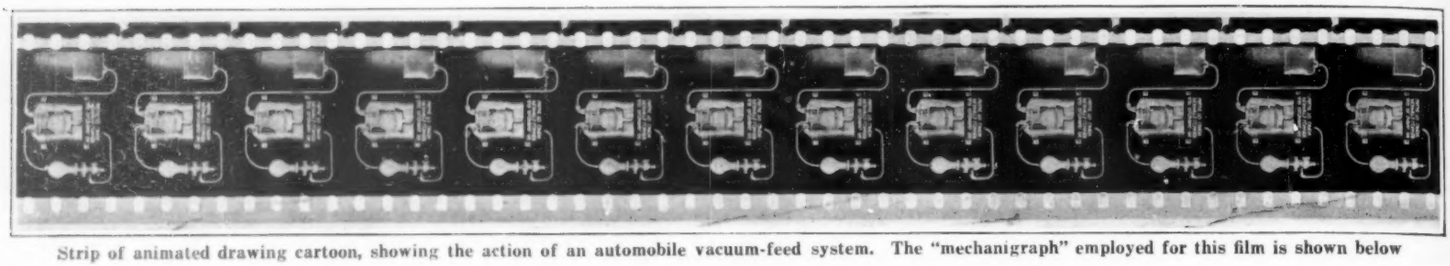
Fireproof Cover for Gas Tanks.—One of our leading rubber companies has developed a fireproof cover for the gasoline tanks of airplanes, which has been accepted by the Government for use on combat and mail planes. The cover was designed primarily for combat airplanes for protection against incendiary bullets and is not only fireproof but leakproof and crashproof as well. The cover consists of a sheet of soft but very tough rubber, one-half inch thick, laid on several plies of high grade cotton fabric. The rubber is applied next to the tank. In tests, it was found that when the gasoline tank is punctured, the rubber immediately closed the hole and stopped the leak.

Italy's Zeppelin Experience has not been an altogether happy one. It appears that the "L-61", which was safely delivered by a German crew to Italy, in accordance with the terms of the Peace Treaty, has sustained such damage that it will have to be broken up. Furthermore, it appears that while in a trial flight, owing to an unexplained failure of the steering-gear when landing, the airship sustained a considerable amount of structural damage, three members of the Italian crew being killed and several others severely injured. The Italian authorities applied to German aeronautical engineers for extra parts and technical services, but were refused help of any kind. Hence Italy has decided that the "L-61" had best be scrapped.

Pullman Air Service.—The Royal Dutch Air Service, which is a private enterprise aided by the Dutch Government, has commenced operating a luxurious airplane service between Croydon (near London), England, and Dutch cities. These flying "Pullmans" provide softly cushioned armchairs, with writing tables for each passenger, and the interiors of the cars are fitted with satinwood panels, mirrors and so on. The arrangements include one departure each day from Croydon at 10 A. M., halting at Rotterdam for 15 minutes, and continuing to Amsterdam. The fare from Croydon to Amsterdam is £10 10s. Between the latter place and Copenhagen air connections are provided. The through fare to Copenhagen is £34 6s.

Sewn Plywood.—In England there has recently appeared a special plywood material for aircraft construction. This material, we are told, must not be confounded with ordinary plywood, for it is something infinitely superior. It is a super-plywood, so claims its manufacturer, which is actually sewn together. The layers are first cemented together with waterproof material and then stitched through in parallel rows about 1¼ inches apart. This gives a rigidity and resilience unattainable by any other method. Weight for weight, it is the strongest material yet evolved. The sheets are made to any desired size or shape up to 8 feet wide by 60 feet long, and from ⅛ inch to ⅝ inch thick, thus eliminating waste in the conversion.

The Navy Design Competition.—In the first open airplane design competition to be conducted by the Navy Department five designs for a new type of naval plane have been accepted on preliminary examination out of forty submitted by thirty corporations and individuals, we learn from *Aerial Age Weekly*. The competition was held to develop a type of plane specially suited for use in spotting and control of battleship gunfire at sea. The five designs, including one each submitted by the Curtiss Company and the Dayton-Wright Company, will be subjected to a final examination to determine the order of merit of the best four. These will be purchased at sums ranging from $16,000 for the best to $3,000 for the fourth.



Strip of animated drawing cartoon, showing the action of an automobile vacuum-feed system. The "mechanigraph" employed for this film is shown below

Putting Motion Into Mechanical Drawings

How Motion Picture Films of Hidden Mechanisms Are Made for Industrial and Educational Purposes

By Howard Greene

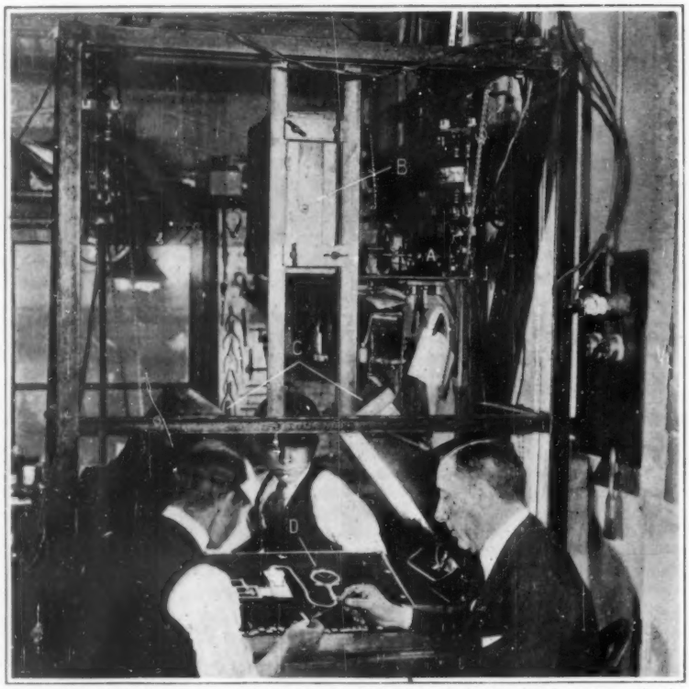
OF all the methods that ever have been devised for instructing and entertaining the public, the motion picture stands first in adaptability and flexibility. The public have become accustomed to trick photography, which seems to make impossible things happen before their eyes: the wildest flights of imagination can readily be made realities—photographically, at least.

While the fullest advantage has been taken of all these facilities of motion pictures in providing amusement for the audiences that throng the motion picture houses, there has been far less activity than there might have been in making use of "movies" for educational and advertising purposes. A certain conservatism, where conservatism might least be looked for, has manifested itself, with the result that the most potent of all methods of making complex matters simple has been neglected to an astonishing extent. Not that there are no films made for instruction and advertising; it is quite true that some have been produced and that they have admirably fulfilled their missions. But this simply makes it all the more a matter of wonder that the supply of films of this nature is as slender as it is; for the field is limitless and the possibilities almost beyond imagination.

Let us explore a little in one corner of the vast field that will some day be completely covered through the agency of the motion picture. A manufacturer of automobiles, we will assume, desires to get before the public the complete story of his car. Or an institute of technology or some other educational institution desires to make the construction and operation of the automobile absolutely clear and understandable. It is desirable to save time in imparting knowledge and to create an impression that will be lasting and accurate and that will not be the result of tedious mental drudgery. How is it to be done?

A specialist in the making of mechanical motion pictures is consulted, the objects sought explained, the data supplied. The making of the picture is commenced.

It is a simple enough matter to make, in the usual way, moving pictures of all parts of the car that are visible. It is equally simple to dismantle the engine, or the gearset, or any other unit, then to photograph the various parts and, in some cases, to show them in motion. But to make clear the actual action under working conditions is a different matter altogether. Take, for example, the familiar vacuum system for keeping the carburetor supplied with gasoline. All that is visible is a little tank and a few pipes. Lay bare the working parts and they will not work. Some recourse must be had to a series of drawings, supplemented by verbal or printed explanations. In the last analysis the whole matter simmers down to the ability of the instructed to use the imagination and so mentally to visualize the apparatus. And it requires something more than an average imagination first to comprehend the analysis and then mentally to construct and finally mentally to operate the system.



Overhead at *B*, is the camera, and just to the right of it, *A*, is the electric motor, reduction gear, trip mechanism and reversing switch. The mercury-vapor lamps in suitable and adjustably mounted reflectors appear at *C*. The "mechanigraph" is shown at *D*. A counter, chain-driven from the shaft, indicates number of exposures made

How the mechanigraphs are filmed by means of the animating stand

Your motion picture engineer makes it his business to sweep away these difficulties, to eliminate the mental drudgery and to get at once to the heart of the subject—to show what the machine is for, what it consists of and how it works when the car is running. And, be it said, in doing this he takes upon his shoulders a task of no mean magnitude, which has a good deal to do with the fact that such pictures are not more common than they are.

At this stage of the proceeding another consideration enters. When the motion picture was in its early youth any picture that moved on the screen was acceptable. After the proverbial nine days, however, people became more discriminating; they demanded—and were given—pictures with an appeal beyond that of mere moving photography. Later there appeared the animated cartoon—the comic line drawing in which the characters and "props" moved in a more or less lifelike way. As a novelty, this was popular for a time, but the novelty soon wore off, and the animated cartoon is fast giving way to pictures that, while still designated as cartoons, have all the earmarks of being motion photographs of real things. They are produced by highly complex systems of double exposure, rephotographing photographs and so on. The old line drawing idea has had its day, and its place has been taken by a picture that looks precisely like what it is intended to represent.

So it is with the instructive and educational mechanical picture. In its best-known form it has been chiefly an animated line drawing. While satisfactory in some respects, such a picture is lacking in the very important element of reality. It is a representation of an idea, rather than a picture of the thing itself. Consequently, the present endeavor is to incorporate in the picture every possible appearance of actuality. And, to go back to the vacuum fuel-feed system, the end is accomplished as follows:

A drawing is made showing the system in cross-section, taken at a point that exposes all the working parts. Separate drawings are made of all the moving parts, all exactly to scale and of the correct form. All the parts are painted until they look quite real. Here a special knowledge of tone values is highly important. The tinting and shading that make an excellent half-tone cut, for instance, will often fall short of the appearance of reality when photographed under the motion-picture camera. For that reason, illustrations of the work are usually far less convincing in appearance than the images projected on the screen.

All the parts are assembled, joints and bearings being used so that they will move as they should. It is usual to make also toned drawings showing all exteriors, to show the external appearance of the apparatus at the beginning of the picture. These exteriors are "dissolved out" later, exposing the working parts.

Photographing the

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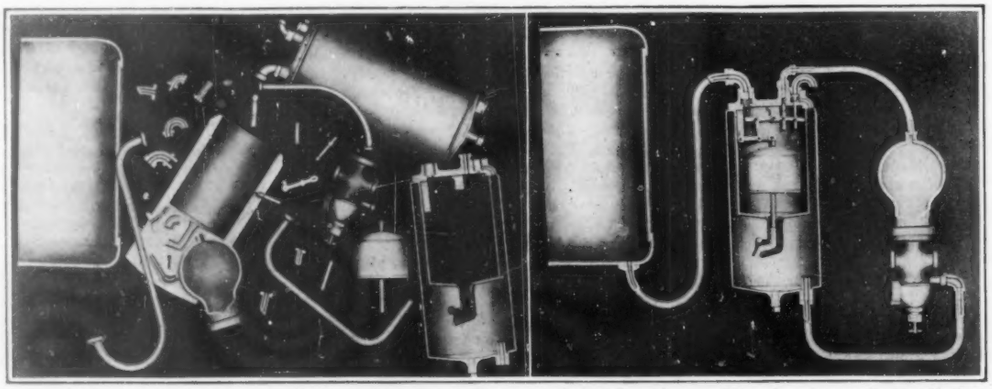

Parts of vacuum-feed system mechanigraph, properly drawn and tinted, and assembly of parts ready for filming

Counting Electrons

By Ralph Howard

MEDIEVAL theologians have been ridiculed because they debated how many angels could stand on the point of a pin. Prof. R. A. Millikan of the University of Chicago gives science's answer to a modern problem that is more or less comparable with this one when he isolates and measures an electron; and he has recently been catching individual atoms and counting the number of electrons which each one has lost when an alpha particle from radium shoots through it. Science for some time has divided the "indivisible" atom into its constituent parts, and identified these as electrons, but Professor Millikan is the first to catch and exactly measure the charge carried by each one of these.

This charge is so small that the number of electrons contained in the electricity which courses through a 16-candle-power lamp filament, and for which we pay one hundred-thousandth of a cent, is so large that if three million people began to count them at the rate of two a second, without stopping to eat, sleep, or die, it would take them twenty thousand years to finish the job.

An electron weighs, according to Professor Millikan, very nearly one billionth of a billionth of a billionth of a gram. Divide this by 500 and you get its weight in pounds. But Professor Millikan has these electrons well under control. He can count the exact number of them which he has caught in a minute oil-drop, with quite as much certainty as he can enumerate his fingers and toes.

In measuring and counting electrons you might imagine one would have to use a pair of scales so small as to be invisible to the naked eye. But Professor Millikan's apparatus is a rather bulky affair. It must weigh several hundred pounds, and it looks like a combination of a magic lantern and a water tank. A 400-watt bulb is installed in a tin box equipped with a strong lens. A water filter a few inches from the lens weakens the heat waves. The light illuminates a tank within another tank, surrounded by a sea of oil. The inner tank contains a partical vacuum, the pressure varying from one one-thousandth of an atmosphere up to an atmosphere.

At the bottom of the tank are two circular condensing plates, the upper one perforated by tiny pinholes. A mist of atomized oil, charged with frictional electricity, is blown through the pinholes between the plates. A high-potential battery is at one side, the negative terminal attached to the upper plate and the positive to the lower. This battery supplies a current of about 1,000 volts. A drop of oil suspended between the two plates travels upward or downward as a reversing key is moved. With a suitable adjustment of the potential it remains stationary, moving neither up nor down. In this position the capture of a positive charge makes it travel upward, of a negative downward. In the recent experiments a radioactive material—in this case polonium—shoots atoms of helium (alpha particles) beneath the drop. Within the tank is a gas, usually helium. One turns a lever so as to expose this gas to the radiation, and it is at once shot through by billions of infinitesimal projectiles, atomic cannon balls. It is these that do the damage.

Now atoms are made up of positive and negative electrons. The positive ones are packed very tight together into an exceedingly small central nucleus, which constitutes the sum of the atomic system. This is surrounded by negative satellites or electrons, which make up the perfect balance of an ordinary neutral atom. But if helium atoms (alpha rays) are going with sufficient speeds, millions of them can shoot through the wall of a thin glass tube without leaving any holes behind. This means that it is possible to shoot one atom right through another just as some giant might gather up an entire solar system and send it whizzing through ours. But when this is done one or more of the constituent electrons of the system is likely to be detached. When one or more of its electronic spots have thus been knocked out of an atom, it is not quite the same as before for it is no longer electrically neu-

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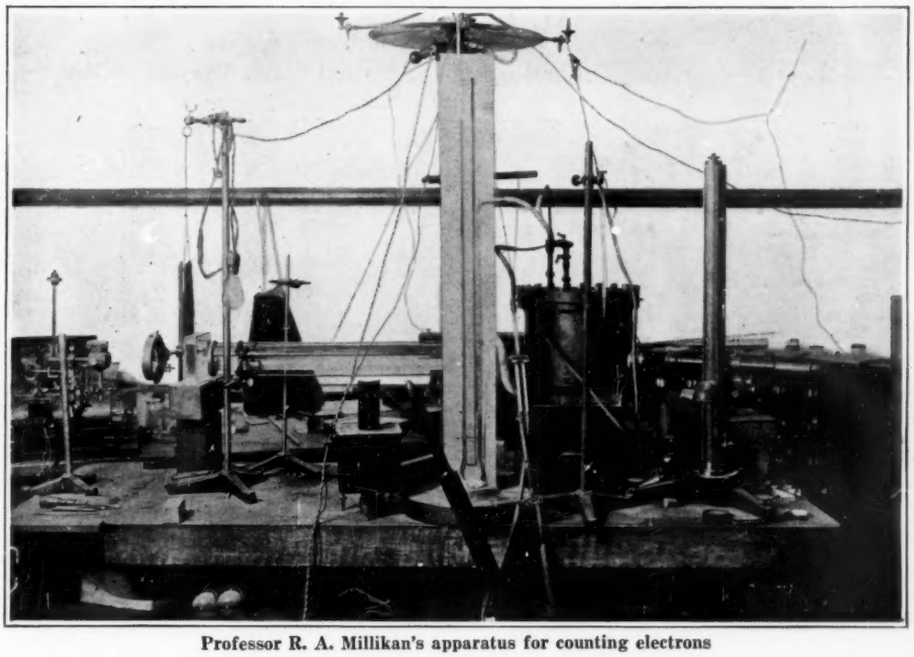


Professor R. A. Millikan's apparatus for counting electrons

Diagnosis by Wireless

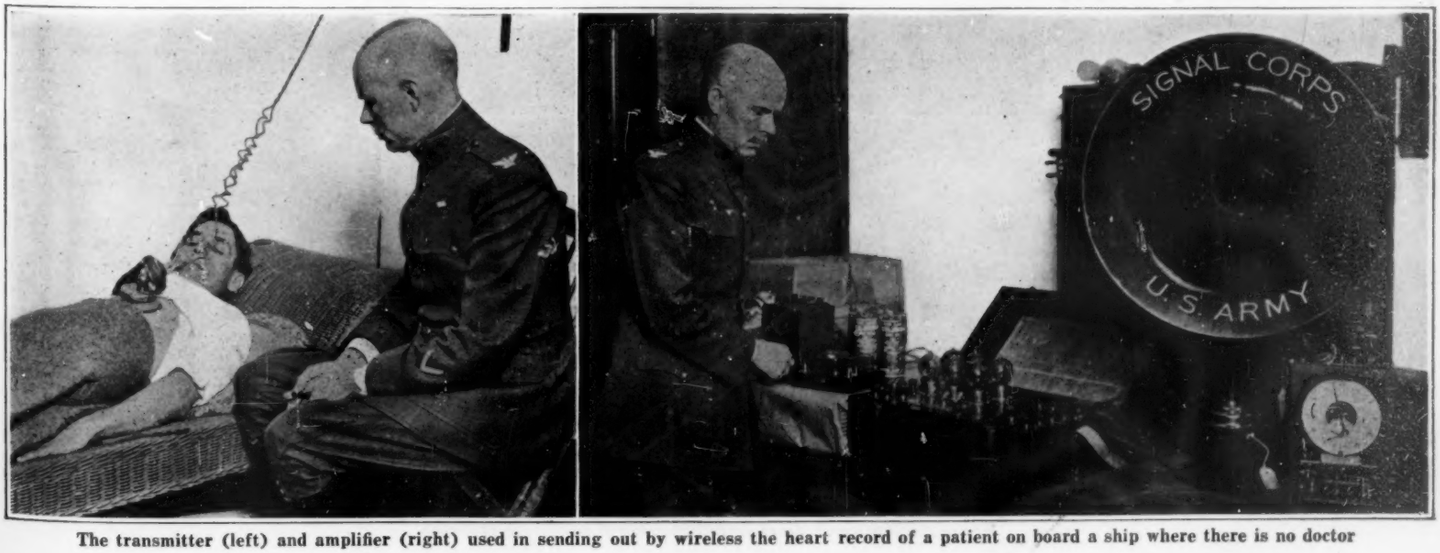
By S. R. Winters

PALPITATION and other troubles of the heart may be diagnosed even though the patient be far removed from medical facilities—say, in middle of the Atlantic Ocean—by application of "wired wireless," the notable discovery of Major General George O. Squier, Chief Signal Officer of the United States Army. The principle involved is similar to that which made possible the multiplication of the volume of the inaugural address of President Warren G. Harding on March 4, the human heart beats being amplified thousands of times.

A demonstration recently to a group of physicians of the United States Army at the Signal Corps Laboratory, Washington, D. C., for the first time revealed working plans of the remarkable innovation. A heart transmitter designed for the specific purpose, resting by its own weight over the heart of the subject under examination, was placed in position. Passage of the blood through the various valves of the heart is responsible for vibrations in an air chamber which faithfully reproduce the manifold actions of the blood when coursing through the valves of the heart. These, in turn, are conveyed over a wire—practical application of "wired wireless"—to an amplifying equipment, consisting of a group of standard vacuum tubes used by the Signal Corps. The tubes are not dissimilar to those employed in wireless telephony and telegraphy reception.

The vacuum tube amplifiers then actuated a special receiver attached to a large horn which distributed sounds reflected by heart beats throughout the building. Doctors attending the novel performance discussed among themselves the peculiarities of the hearts of different subjects as the actions were magnified. Distance is an irrelevant factor when heart beats are to be studied by the vacuum tube amplifier. The high frequency carrier current, a distinguishing feature of the progeny of Major General Squier when compared with radio in common, transmits sounds along a wire by means of electric waves guided by an ordinary telephone line. Thus, there is established a perfectly silent vehicle for conveying the delicate variations of sound produced by the heart to the receiving apparatus.

Comments of physicians attending the demonstration were of a varied character as to the practical application of "wired wireless" in diagnosing heart diseases. An occasional opinion was to the effect that the use of magnifying equipment would involve the refashioning of medical education as it pertains to the study of the heart. Other army doctors were unreserved in praise.

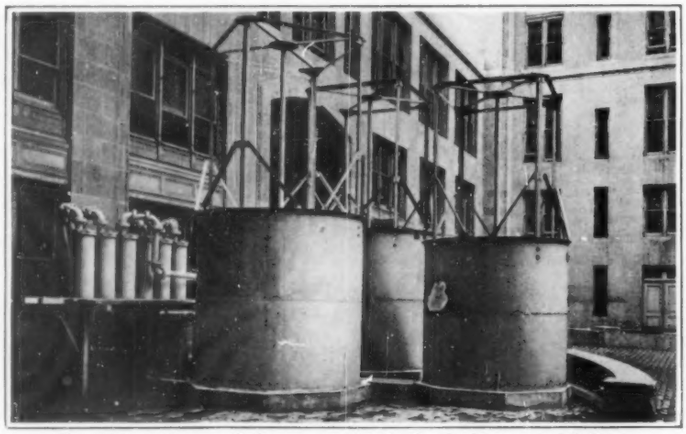


The transmitter (left) and amplifier (right) used in sending out by wireless the heart record of a patient on board a ship where there is no doctor

Below Zero

The Low Temperature Laboratory of the United States Bureau of Mines

WHEN the plants for extracting helium from natural gas were started in 1918, owing to the pressure in connection with all war undertakings, there was no time nor opportunity to do any research work on a small or semi-commercial scale. It was necessary to design and build the plants as rapidly as possible, and to do whatever experimentation was required in the plants themselves. Shortly after the two experimental units at Fort Worth were operating, the advisability of research work in connection with the undertaken was plainly seen, and some vapor-pressure work was started at the Bureau of Standards under a coöperative arrangement with the Bureau of Mines and the Army and Navy. Last year arrangements were made with Dr. Harvey N. Davis, of Harvard University, and Dr. F. G. Keyes, of Massachusetts Institute of Technology, to do further work along this line, and this is now in progress. There is, however, a distinct addition in having a thoroughly equipped laboratory which is available at all times for research work in connection with the plants and this has been accomplished through the establishment this year in the Bureau of Mines at Washington of a Cryogenic Laboratory. The funds were allotted to the Bureau of Mines last June through the interest of Commander A. K. Atkins, of the Navy, and Colonel C. DeF. Chandler and Lieutenant R. S. Olmsted of the Army Air Service, and at the present time Lieutenant Commander S. M. Kraus and Major P. E. Van Nostrans are acting for the Navy and Army, respectively, under the coöperative agreement with the Bureau of Mines.



The air purifiers and the storage tanks for hydrogen and helium

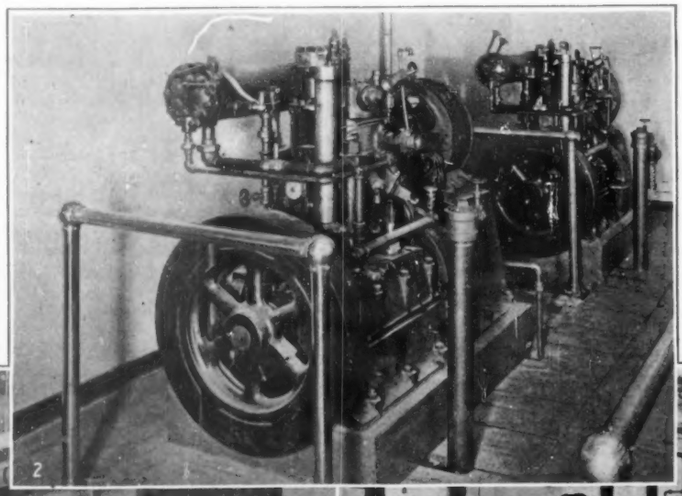
The equipment is now installed in the new Department of Interior Building at Washington. It consists of two 4-stage Norwalk air compressors, rated at 75 cubic feet of free air per minute each, compressed to 3,500 pounds per square inch at 135 revolutions per minute. These compressors are driven by two 50-horsepower variable speed, 220-volt, direct current motors. These compressors will be used for making liquid air and for obtaining the necessary refrigeration for other purposes. From 15 to 20 liters per hour of liquid air can be obtained. In addition, there is one 3-stage submarine type compressor, rated at 28.87 cubic feet of free gas per minute at 150 revolutions per minute, compressed to 3,000 pounds per square inch, and driven by a 15-horsepower variable speed, 220 volt, direct current motor; also one 3-stage submarine type compressor, rated at 16 cubic feet of free gas per minute. The first one will be used for liquefying hydrogen and the second one for a liquid helium cycle. All the compressors have unloading valves so that the capacities can be varied within wide limits.

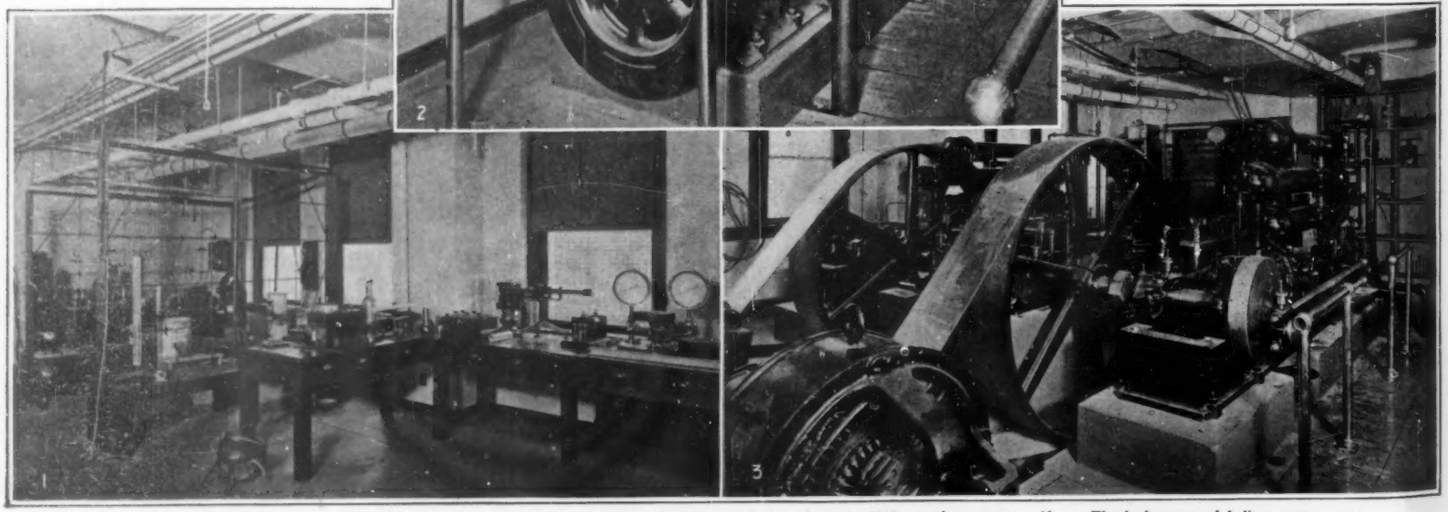
There are two 300 cubic feet and one 200 cubic feet gas holders for holding hydrogen and helium; four smaller holders for storing gas samples; a machine shop equipped with 13-inch engine lathe, bench lathe, shaper, two drill presses, grinders, pipe tools, etc. There is also available one low temperature expansion engine, air and hydrogen liquefiers, and the necessary physical and chemical apparatus to go with the above equipment.

The object of the laboratory is two-fold. Its first and main object is to obtain scientific data that will be of use in the operation of the helium plants so as to get more efficient operation, and reduce the cost of helium production. Its second and subsidiary use is to furnish facilities to a limited number of American scientists who may be interested in using the laboratory for special low temperature work, particularly along lines that will not be covered by the technical men of the Bureau of Mines.

At the present time the work that is being carried on is along two definite lines. First, vapor pressure work in connection with ternary mixtures, and secondly, in connection with the purification of helium by means of charcoal at low temperatures. It has been found that charcoal at low temperature has a selective action on nitrogen absorbing this gas, but not absorbing helium, or at least to only a very small extent. This property has been adapted to purifying helium both from nitrogen and from air.

The Army has constructed a repurification outfit on two railroad cars. The first car contains the power plant, and the second car contains the compressors and refrigeration equipment. The Bureau of Mines has been asked to design and install a charcoal repurification unit on this car, and this work is now under way, the equipment being partially constructed in the Cryogenic Laboratory, and the whole will be tested out in this laboratory before installation in the car. If this work is a success it is probable that it will be of sufficient value to install in the production plants also in order to step up the cruder product which is obtained in the plants to 10 per cent helium, which can be obtained by means of the charcoal. The importance of having the higher product is exceedingly great as a dirigible filled with 100 per cent helium rather than 94 per cent will have a much greater lifting power, and also a wider range of operations. It appears as though helium, after all, may come into more general use for dirigibles, in place of hydrogen.



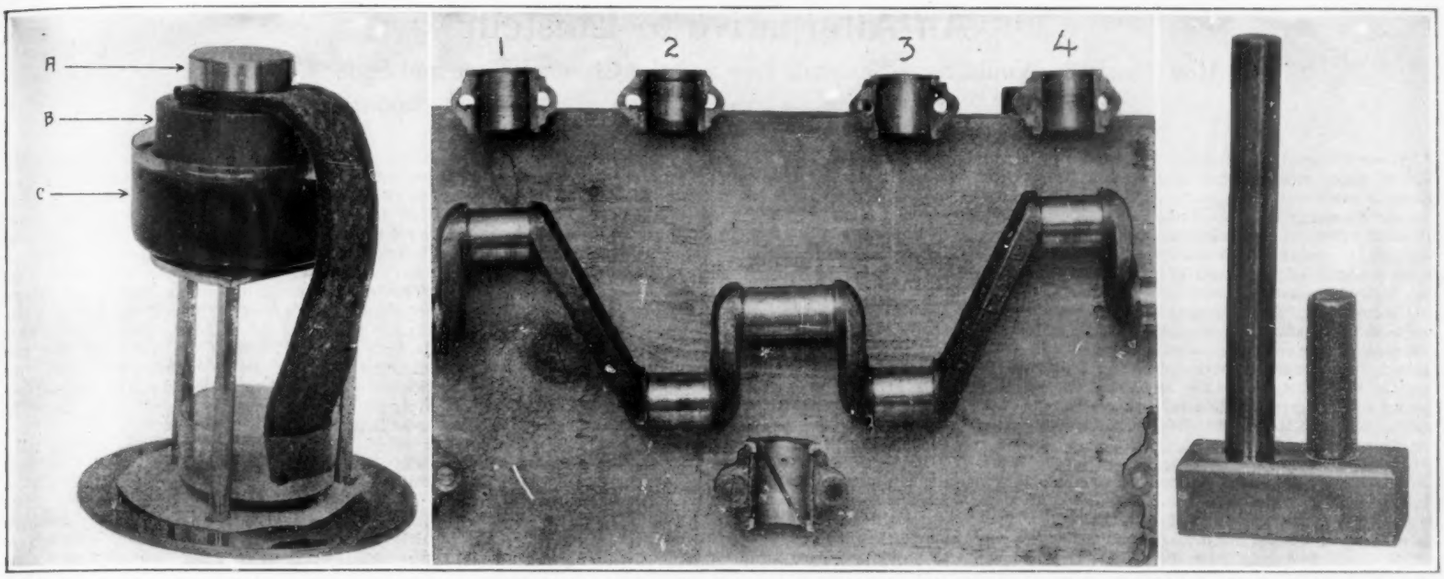


Left: General view of the low-temperature laboratory. *Right:* Four-stage air compressors that work up to 3500 pounds pressure. *Above:* The hydrogen and helium compressors

Where the Bureau of Mines investigates low-temperature problems

Eye-Strain and the Movies

A COMMITTEE appointed by the Illuminating Engineering Society of England to inquire into eye-strain resulting from watching the movies, has just made its report, which is published in the *British Medical Journal*. The committee finds that the chief strain on the eyes comes from the pictures being shown too high up, so that the eyes of the spectators in the front rows have to be raised. It recommends that the height of a picture on the screen be such that the angle formed by lines from the center of the top and the center of the bottom to the eye of a spectator in the front row be not greater than 35 degrees.



Left: Test to show porosity of the new bearings. *A* is a brass weight, *B* the rod of genelite, *C* the tank from which the oil is being "siphoned" to the tank below. *Center:* Genelite bearings of a four-cylinder car after 20,000 miles. *Right:* The relative amount of graphite in the new bearings, the small column representing the volume of graphite and the large one that of the entire substance

Tests and demonstrations of the new self-lubricating bearing material

Self-Lubricating Bearings

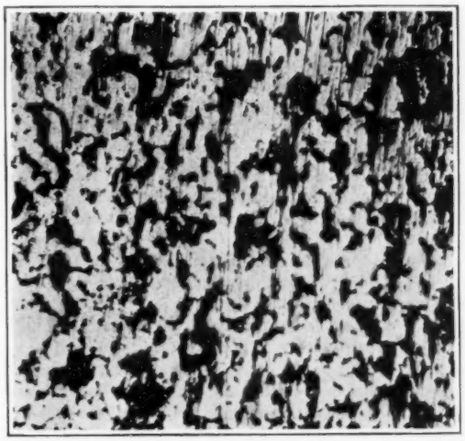
A NEW bearing material which is a mixture of graphite and high-grade synthetic bronze, and which has self-lubricating qualities of a high order, has recently been developed in the G. E. Research Laboratory following successful tests under service conditions. Perfection of this material—genelite—came after research extending over a period of several years.

The new material contains graphite amounting to 40 per cent by volume of the whole mass. Tests have shown a high degree of porosity, the metal being able to absorb as much as 2½ per cent by weight of oil. One of our illustrations shows a piece of apparatus set up to demonstrate this feature of the material. Oil from the upper beaker is siphoned into the lower through the rod of genelite and the woolen wick. This characteristic is made use of in high-speed applications where oil is applied to the outside of the bushing and carried through to the bearing surface by capillary attraction. Another characteristic is that the bearing never siezes or freezes, that is, the metals of the shaft and the bearing never flow or weld together. If a bearing sticks, owing to too close a fit, all that is necessary is to reassemble it with the proper fit, no damage being done to the shaft or bearing. We illustrate the crank pins and main bearings of a well known make of automobile after 20,000 miles' service, the crank pins being equipped with these bearings. The main bearings were badly worn as seen from the grooves in the shaft and the appearance of the babbitt, while the crank pins are barely polished, and the genelite bearings in the big ends of the connecting rods have not yet come to a full seat.

Among the self-lubricating uses for the new bearing are brake-rod bushings, clutch-centering bushings, throttle control, fan and pump-shaft bushings, where such material saves much trouble and expense of overhauling and repair. On the main engine genelite has proved useful for places such as main bearings, crank-pin bearings and piston-pin bushings, which are supposed to be well lubricated at all times, but where wear is likely to be excessive.

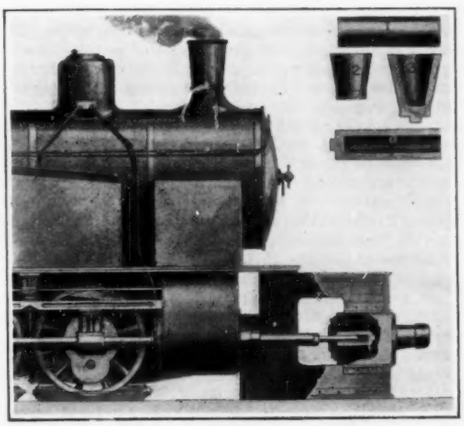
The metallic component of the new bearings is made from the oxides of tin, lead, and copper, composing a high grade bronze, all the materials being in a finely divided state. Graphite is added in sufficient excess quantity to reduce the oxides to the metals, and leave the required graphite content in the finished material.

The mixture, still in powdered form, is then pressed as nearly as possible to the required shape in massive metal molds. In this pressed form it will not stand much rough handling, so it is given a final bake, which sinters the metals together into a homogeneous bronze, holding the graphite uniformly distributed throughout its mass. We show a photomicrograph that brings out the even distribution of the graphite particles. The white spots are the bronze and the black ones the graphite. The baking serves to clamp the graphite particles securely within the mass of bronze so they cannot be washed out or detached save by dissolving away the surrounding metal with acids.



Photomicrographic cross-section of the new bearing, showing uniformity of mixture. The black is graphite, the white bronze

The material has the general appearance and body of bronze, but the characteristics are different. It does not machine readily, but can easily be ground, which has been found to be the best method of handling it. Neither has it the physical characteristics of bronze, having very low tensile strength, but withstanding high compressive strains.



A steam locomotive doing emergency service as a punch-press, and the four stages of the work turned out with its aid

A Steam Locomotive as a Punch-Press

A VERY ingenious device, used in France for drawing down 75-millimeter steel shells during the war, was described recently in the proceedings of the Societé des Ingenieurs Civils de France. A curious fact is that a locomotive plays the principal rôle.

According to the account, the Bordeaux works of the South of France Railway Company, like all other works in France, were called upon at the outbreak of war to adapt a portion of their machinery to the making of the "75" shells, starting from steel bars cut to length, as shown at 1. These were upset hot in a die and given successively the shapes shown at 2 and 3, in upper right-hand corner of drawing.

The cup thus obtained had to be drawn down to the cylindrical shape shown at 4, and for this the Bordeaux works had no machine available. Considering the time it would have taken to build, or to await the delivery of, a hydraulic press for the purpose, they looked around for temporary means of increasing the shell supply. At first it was thought that the drawing-down operations might be done in a spring-testing machine, but it was soon realized that this machine was unable to give the required 80-ton to 100-ton pressure. Attention was then turned to a powerful modern locomotive engine built for service on heavy gradients, which happened to be lying idle pending repairs. A trial was rapidly prepared for which the locomotive was moved to a position in front of a stout wall on which the drawing-down die-holder was supported. The locomotive was then raised so that the wheels were clear of the rails, and a punch was fitted to the tail rod of one of the pistons. A cup was then heated to a red heat and placed in the die, when the opening of the regulator-valve drove the punch forward and caused the cup to pass through the die. The test being successful, it remained necessary only to make the installation more convenient for use.

The manner in which this was accomplished is shown in drawing. The buffer beam of the engine was replaced by a much stronger one, built up of plates and sections, and fitted, in front of the cylinder utilized for the drawing-down operations, with the die-holder, a kind of casing open at the side for inserting the die. A catch against which the die butts horizontally when it is inserted fixes it in a suitable position so that the axis of the die is on the same vertical plane as the axis of the piston, the die being further supported on the lower part of the casing in such a way that its axis was slightly lower than the piston axis. As was done when machines specially designed for this operation were used, the reduction was effected in three stages, each using a smaller die than the preceding one.

The cups were heated in a reverberatory furnace erected close to the locomotive. On leaving the furnace, the base of the cup was slightly cooled by immersion to a depth of from 2 to 3 centimeters in a tank of water maintained at a constant level. At the same time, the bottom of the cup was freed of scale by means of a kind of milling cutter worked by a small portable

(*Continued on page 478*)

An Alternative to Einstein

How Dr. Poor Would Save Newton's Law and the Classical Time and Space Concepts

By the Einstein Editor

ON our editorial page for May 14th we spoke harshly of those who criticise Einstein as a plagiarist. There is another kind of criticism that is on a different and an altogether respectable basis. Regardless of ultimate acceptance or rejection, Einstein's pronouncement is a great scientific achievement. He has laid down a series of postulates of extreme interest, and has derived from them consequences of equal interest and importance. Nothing that we may subsequently learn of the realizability of his postulates or the occurrence of their consequences can in any way detract from his work. But while retaining all admiration for the structure and the labor that went into it, the scientist may still question both realizability and realization, or criticise Einstein's theories on any other scientific ground.

In this spirit Dr. Charles Lane Poor, in the SCIENTIFIC AMERICAN MONTHLY for June, asks, and answers in the negative, the questions "Is Einstein's system the only set of assumptions that will explain the phenomena on which he relies for verification; and if not the only set, is it the best set?" Dr. Poor finds the demands made by relativity upon his "common sense" a little too great for his ready submission; he seeks an alternative which shall not so offend. To his own satisfaction and we expect to that of many readers, he finds a way of saving the conventional notions of time and space, and with them Newton's law of gravitation.

Dr. Poor points out that to establish the Einstein theories it will not be enough to show that they explain the facts of nature. We must at least attempt to show that no other hypothesis will do this equally well. Of course in practice we should hardly hope to accomplish this with complete rigor; we should in any event have to descend to the choice of that cosmological system seeming to have the most in its favor when we come to weigh probabilities. The average physicist we believe will prefer Einstein's explanation to Newton's as bolstered by Dr. Poor, for the very reason set forth so ably by one of our essayists—that the one is a generalization, while the other is limited in its scope to the particular problem that brings it up. Be that as it may, Dr. Poor must be met on his merits; and because of the extreme interest of his suggestion we give him space to set it forth in the MONTHLY, and make this résumé here.

AS the Einstein theories are surveyed, with the passing of time, more and more in the light of cold reason and less in that of emotion, it becomes increasingly plain that the evidence in their favor is entirely internal. The Michelson-Morley experiment itself has had such doubt cast on it, in view of recent discoveries as to the behavior of metals, that it seems necessary to perform it anew in a manner that shall make it less dependent upon the properties of the material apparatus. The eclipse observations, useful as they were in focusing popular attention upon the theory and its "verification," are so unsatisfactory that the eclipse of 1922 is to see further work in this direction which is designed to replace rather than to supplement what was done in 1919. The spectral shift is so tangled up with similar effects from other causes and with observational difficulties that it seems doubtful whether it will ever amount to anything as a test. Wherever we attempt to check up Einstein, we find that accidental and systematic errors of observation and calculation bulk such a large percentage of the effect we are trying to observe, that we cannot be certain whether favorable results are the result of the effect or of the error, or whether an unfavorable outcome is to be accepted as significant. Dr. Poor now completes the case by showing that even in the matter of Mercury's perihelial advance, of which the Einstein proponents have made such a point, acceptance of relativity is only to be put on the ground that we want to accept it, and not at all on the ground that we have to. Everybody, the pure physicist who feels that he simply must have the Einstein theories as well as the man of hard, classical common sense who doesn't see how he is possibly going to reconcile himself to them, will be interested in what Dr. Poor has to say in the SCIENTIFIC AMERICAN MONTHLY for July, and in the Einstein Editor's present comments on this paper.—THE EDITOR.

For many years Newtonian theory has failed to account for the behavior of Mercury. If this planet were alone in the skies with the sun, according to Newton his orbit would be a perfect ellipse, quite fixed relative to the sun. With the other planets accompanying him in his flight, this ellipse instead of being fixed should push its sharp end slowly about, so that after many revolutions the orbit would point in an observably different direction. This "advance of the perihelion" (the sharp end of the orbit) should amount to 537 seconds of arc per century.

Under Einstein's theory this advance should still take place; but in addition there should be a further advance of 42 seconds per century, independent of the other planets—an advance which would occur even if Mercury were the only planet. We actually observe an advance in Mercury's perihelion of 579 seconds per century—the sum of the pure Newtonian and the Einsteinian advances. Einstein appears to be brilliantly verified. But the whole story has not been told.

The situation that exists with regard to Mercury exists in the cases of all the other planets. Only, because in no case is the orbit so sharply elliptical as Mercury's, and because the other orbital speeds are much less than his, the magnitude of Einstein's effect is less in the other orbits and precise location of the perihelion more difficult. At the same time the Newtonian advances of the other planets are mostly much larger than for Mercury, so that for them Einstein's corrections are a small percentage of the total observed advances. Their importance has therefore been minimized on the ground that the margin of observational error swallows up the predicted correction.

Dr. Poor makes it appear that the discrepancies between Einsteinian prediction and observation are not so negligible as they have been represented to be. He shows that while Einstein accounts for practically all the divergence between observation and calculation in the case of Mercury, and markedly reduces the discordance in the case of the earth, he accounts for a very small part of Mars' failure to maintain his schedule, and actually makes the case of Venus, already bad enough, more than twice as serious.

Moreover, the perihelia are not the only features of the orbits that misbehave in a manner which Newton has not been able to account for. The inclinations and the positions of the nodes (the points where the orbits pierce the plane of the earth's track) fail to check up, by anything from zero in the case of Mars' node to ten per cent in the case of Venus' inclination. And Einstein offers neither help nor hindrance; his results here differ in no respect from Newton's.

Simon Newcomb made an exhaustive study of the possibilities in the case of Mercury's perihelion, which has had more attention and been featured more as a Newtonian failure than any of the others. He considered every explanation which had ever been advanced or which he could himself imagine—a group of asteroids inside Mercury's orbit, such a group outside the orbit, the hypothetical planet Vulcan, the matter surrounding the sun and giving rise to the zodiacal light, etc. He investigated mathematically the possibility of the gravitational influence of any of these aggregations of matter being enough and not too much to cause the observed effect, and reported in the negative in each instance. He finally concluded that while there was of course no independent evidence in its favor, the suggestion that best accounted for Mercury's behavior without disturbing the balance of the universe in any other respect was Hall's proposal to modify the law of gravitation, and make it read "inversely as the power 2.000,000.1574 of the distance"—the figure named having been deliberately chosen to bring about the desired result. While this is one of the most striking instances on record of the empirical formulation of a law to suit observed facts, it did not take hold of physicists or astronomers, and they preferred actually to let the problem stand unsolved. This of course is again because of the extremely special character of the explanation offered.

Dr. Poor returns to the material explanations, and finds that Newcomb fell into a rather natural error in one part of his work. After correcting this, Dr. Poor is able to present a set of physical assumptions which, under the pure Newtonian law, do all that Einstein's do in the matter of straightening out the planetary discrepancies—which do more than Einstein does, in fact. He starts with the known fact that there is a great deal of matter wandering about loose in the region occupied by the orbits of the minor planets. This does not consist of a continuous gaseous envelope about the sun, but rather of an immense number of separate solid particles, each pursuing its own separate orbit. These planetesimal bodies are of all sizes from that of a pinhead up to that of an object measurable in feet or even perhaps in fractions of a mile. We know that this circumsolar lens, as Dr. Poor calls it, exists; the particles are too small to be seen individually but collectively they reflect enough sunlight to us to form the zodiacal light.

In computing the planetary orbits the mutual influences of the several planets have been worked out most carefully—so carefully that when Uranus refused to run on schedule the position and size of the planet beyond him that would be necessary to account for his vagaries were computed with sufficient accuracy to lead to the discovery of Neptune. But no computation of planetary orbits has ever gone further than this. The matter of the zodiacal light has always been ignored, on the assumption that its aggregate mass was not sufficient to cause appreciable discrepancies. The astronomer is continually making assumptions of this character, designed to make it possible for him to solve his equations in his own lifetime instead of leaving them as a legacy to his grandchildren; but Dr. Poor now challenges the particular assumption involved in the neglect of the circumsolar lens, and replaces it with a new assumption regarding the mass and density of this lens.

It is not possible, on the basis of present knowledge, to determine the quantty of matter that is here present, or its approximate distribution. It is however clear that its density must decrease as we recede from the sun. It is then possible to work the problem backward, to do just what Adams and Leverrier did in estimating where to look for Neptune, and to arrive at a distribution of the circumsolar matter that would account for Mercury's observed behavior. Even here, however, we must have simplifying assumptions. We cannot introduce into the equations of motion of Mercury the condition, which presumably exists, that the density of the circumsolar envelope varies continuously; we may only approximate to this condition by assuming that it is divided into several zones, each of uniform density. Itself an approximation, this is plainly a vast improvement over the approximation that ignores the lens entirely.

Dr. Poor finds that to account for the facts in the case of Mercury he needs three such zones of gravitating matter, each being assumed of elliptical shape to conform to the general planetary scheme. He has a certain amount of freedom; his equations fix neither the mass, nor the distance, nor the ellipticity, of his several rings, but merely the product of these three. There is then a great range of choice for the three elements themselves, some combinations being of course absurd, but many being entirely in accord with the physical possibilities. With the freedom of choice which he has between the latter, Dr. Poor is able to select values for his distances and densities which shall not alone resolve the Mercury problem, but which shall at the same time help out with the discordances of the other planets.

If the circumsolar lens possess the numerical values attained by Dr. Poor, its gravitational influence added to all the previously known factors would account for Mercury's perihelial advance with absolute accuracy; for that of Venus within 0.5 per cent; for that of the

(*Continued on page 479*)

New Sources of Pulp and Paper

The Direction in Which the Paper Maker Will Turn When His Timber Supply Is Gone

By Thomas J. Keenan, F. C. S.

THE growing scarcity and ascending cost of the raw materials used in the manufacture of pulp and paper are reflected in the prices which consumers are required to pay for the finished product. The larger city dailies appear to be less affected than the country weeklies and trade journals, for the reason, perhaps, that most of them obtain their supplies direct from the paper mills on long-term contracts, or else control mills of their own, the entire output of which is absorbed by them.

... body of all newspaper sheets consists of pulp produced by a mechanical process of grinding logs of spruce, balsam or hemlock against revolving stones in the presence of water. This pulp alone can be formed into paper with the addition of a small proportion of clay, but it is customary to strengthen the sheet by incorporating with the groundwood pulp a definite proportion—10 to 20 per cent—of chemical pulp made by the sulfite process. The preferred wood for the manufacture of sulfite pulp, which is made by boiling the wood under pressure, in bisulfite of lime solution, is spruce, though other woods, as hemlock, balsam fir, white fir and tamarack, are also used commercially.

The spruce and fir forests of the northeastern states, where our pulp and paper industry has had its greatest development, have been practically exhausted, and American paper manufacturers have been forced to seek supplies of this raw material in Canada. The Canadian pulp and paper industry has forged ahead of late years until its production of pulp and paper has reached enormous proportions, putting pulp and paper manufacture at the head of all the Canadian industries.

In addition to the pulp manufactured in our own mills for conversion into paper, a large volume is now imported from Scandinavia and Germany, as well as from Canada, our home production being wholly inadequate to meet the demands for the many kinds of paper which are manufactured in addition to newsprint paper.

Coincidentally with a diminishing supply of the woods which form the basis of newsprint paper, there has been more than a normal increase of consumption of this class of paper, owing to a greater use of newspaper advertising on the part of merchants and manufacturers.

Although there has been a good deal of ill-informed speculation concerning possible new sources of papermaking material, and many futile attempts have been made to utilize various reeds and grasses, waste paper, etc., the experiments of Brand, under the auspices of the United States Department of Agriculture in 1910, demonstrated the feasibility of converting cereal straws into a satisfactory paper pulp and commercial applications of the process or processes similar to it have already been made.

It is inevitable that paper manufacturers will turn eventually to sources of pulp other than timber, though for numerous kinds of paper trees will remain the preferred material. The use of cotton linters is a new and promising development. In the pulp and paper laboratories of the Forest Service at Madison, Wis., it has been proved experimentally that many western woods heretofore unused are well adapted for conversion into paper pulp by the processes ordinarily employed. Spruce can be replaced for pulp manufacture by twenty or more different woods, but the fact that it and trees similar to it take thirty-five or forty years to reach maturity is still a hindrance to their constant use. Timber trees cannot be treated as the agriculturist treats crop plants and be sown, cut and grown again as annual harvests, though some of the larger paper manufacturers have undertaken forestry work looking to the reproduction of wood on cut-over areas. The West Virginia Pulp and Paper Company, in this country, and the Laurentide Company, in Canada, were pioneers in conducting operations for timber conservation and insuring future supplies of papermaking woods.

The solution of the problem is, however, to be looked for in another direction. For years there has been used in the manufacture of tough papers, bag and wrapping papers, a fiber called Manila hemp, which is no hemp at all, but a species of banana, belonging to the Scitamineae family, the genus being Musa. Manila hemp is known to botanists as *Musa textilis*, while the edible banana of commerce is *Musa sapientum*. The leaf stalks of the various species of banana are rich in cellulose membranes which give them first place as available sources of paper stock, and it might be a profitable undertaking to plant the waste areas of the subtropical regions of our country, lower Florida and California, with the wild banana or other fiber yielding plants not heretofore employed as raw material for paper making. They could be treated as annual crops to yield a steady supply.

An American company has been formed for the utilization of fiber extracted from the wild banana by a new method involving the use of a fiber-decorticating machine which separates the fibers mechanically, and leaves them clean of incrusting material and ready for cooking in the pulp mill. The promoters of the enterprise are confident of developing within a few years a tropical industry capable of furnishing pulp and paper mills in the United States with a plentiful supply of papermaking material. Operations are now being conducted on a commercial scale in the Republic of Panama, near the Canal Zone.

Although reeds and grasses as raw materials for papermaking are of little importance at the present time, it may be said in favor of their use that the harvest is large and the plants are less subject to decay and rot in keeping than, for example, bamboo, banana and similar solid stalks which allow no ventilation in piling. Reeds and grasses are characterized by hollow cylinders which permit the passage of air and so obviate the decay resulting from the breaking down of vegetable matter which is more solidly massed in

(*Continued on page 479*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Gas Producer

To the Editor of the SCIENTIFIC AMERICAN:

Central stations in America operate a total of only 18,500 hp. in producer-gas engines, according to a recent estimate. This is a little under 10 per cent of the total of internal combustion engines in central power plants. The use of producer-gas in such places and in outlying plants should be much increased. Why is not more producer-gas used in America? In the SCIENTIFIC AMERICAN for Feb. 19, 1921, Ralph Howard discussed the shortage and waste of fuels, especially coal, and suggested the extended use of the gas producer or generator and internal combustion engine. He also stated that the practicability of this type of prime mover is not generally known, although it is constantly being improved. Mr. Howard gave a brief description of the apparatus and said that steam control, which is used to enrich the gas (carbon monoxide) has not been solved until recently.

It is rather a curious thing why, in this country where hundreds of thousands of tons of waste products, easily collected, are burned or dumped into the sea every year, manufacturers have not developed producer-gas plants similar to those so successful in England and Europe. Considering the limitations of the petroleum supply, and the ever increasing consumption of crude oil and its distillates, the subject of producer-gas is very opportune. We have enormous reserves of coal, yet the efficiency in burning under boilers is very low. Up to 1913 there had been considerable investigation concerning the use of producer-gas. In that year the U. S. Bureau of Mines issued Bulletin 55 by R. H. Fernald, covering the subject fully. There were then 722 producer plants, 610 burning anthracite, 77 bituminous coal, 32 lignite, 1 wood and 2 oil. The advent of the oil engine practically stopped development of producer-gas units. It appears that this type of plant needed special fuels in order to reduce the labor charge. In fine, it failed to utilize low-grade fuels or waste products. The above-mentioned installations were mostly in the northeast and north-central states.

Australia, a country minus oil (so far) and little water power, also had a development of producer-gas plants from 1904 to 1912; since then their use has gained considerably. The fuels so consumed are charcoal, coal, coke and wood. These include lignite and 6-ft. lengths of fire wood. At the Waihi gold mine in New Zealand, six 200 hp. engines used producer-gas, the cost of power being 6 pence (12 cents) per hp.-day. British firms have advanced the operation of these plants, and now make producers and engines to work without trouble on such materials as charcoal, cocoanut shells, cocoa, coffee and rice husks, coke, cottonseed, corncobs, olive, sawmill and sugar cane refuse, peat and wood. In America there are enormous quantities of such available. Consider the almost criminal waste at our sawmills, cane-sugar mills, flour mills, the neglected peat beds of North Dakota, and the refuse of a hundred and one industries. All can be converted into gas in the producer and drive engines in central plants and other localities where power is needed. The Bureau of Mines has published a number of bulletins and technical papers on the subject, so engineers interested should secure copies. Foreign practice is also discussed. There is nothing complicated or mysterious about the suction gas (producer-gas) system, and its further utilization is desirable as a conservation measure and for cheaper power.

MAX VON BERNEWITZ.

Brooklyn, N. Y.

An Appeal for Aid

To the Editor of the SCIENTIFIC AMERICAN:

I was approached some months ago by the present director of the Physical Laboratory at Bonn in behalf of his predecessor, the eminent physicist, Prof. H. Kayser. Professor Kayser has been recognized as the world's leading authority on laboratory spectroscopy and he is the author of the monumental work in six large volumes, published between 1900 and 1912. Upon his retirement last year at the statutory age for the University of Bonn, it proved to be impossible for him to live in any comfort on the depreciated pension allowed to him. It was therefore proposed that his remarkable library of books and pamphlets on spectroscopy should be sold so that the money could be used for his personal maintenance. The value of between $2,000 and $3,000 was placed upon this library. It seemed to me that it would be much more appropriate for friends and admirers of Professor Kayser or others having an interest in the University of Bonn, who might be persuaded to buy the library and present it to the laboratory at Bonn, with the understanding that it was always to be at the disposal of Professor Kayser during his lifetime.

Professor Kayser's nature and characteristics are such that no one could assign to him any of the qualities which have been justly condemned in many of his countrymen during the late war. On the occasion of the 250th anniversary of the Royal Society of London he was one of the delegates from Germany at the numerous meetings of the celebration, and in an after-dinner speech at Cambridge his attitude was of a most friendly character to his hosts. Those were days in 1912 when tension was already beginning to be felt between Germany and England, and it may be recalled to the credit of some of the eminent physicists who were delegates from Germany that they brought as a testimonial of their regard for the Royal Society of London a special memorial tablet and address appropriate to the occasion. By one of the witnesses, at least, this was regarded as an expression of solidarity on the part of the German educators with their English colleagues.

I very much wish that this library could be saved for Professor Kayser's use and its money value be devoted to his comfort.

EDWIN B. FROST.

Yerkes Observatory,
Williams Bay, Wis.

An Old Catch Question in New Dress

To the Editor of the SCIENTIFIC AMERICAN:

Will you be kind enough to print the following question in your journal?

"A bird sitting on a perch in a cage is weighed together with the cage. How does this total weight compare with the weight of the same cage but with the bird flying in it? Why?"

Perhaps some of your readers will comment on this problem.

A. B. C.

Brooklyn, N. Y.

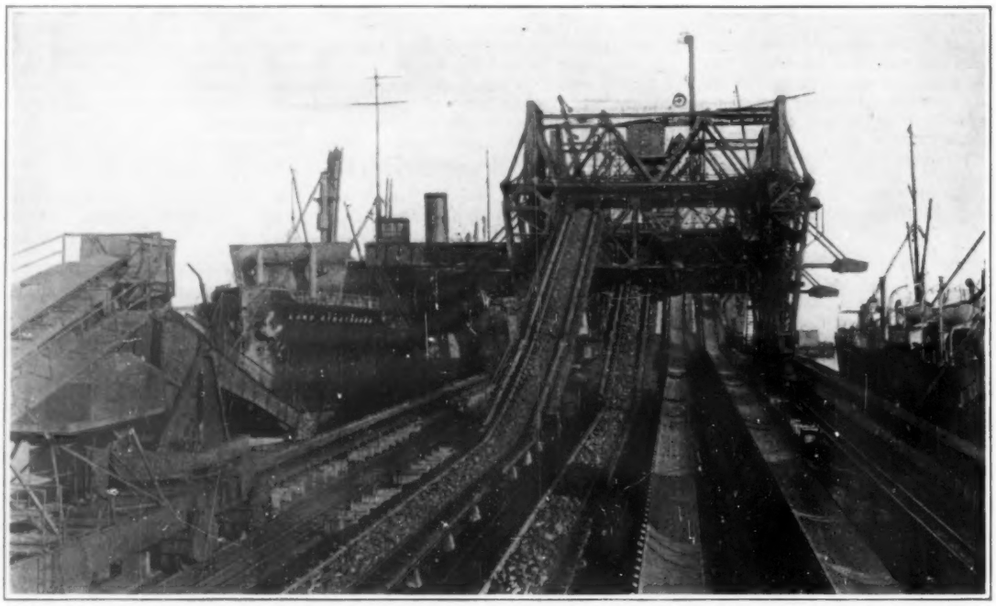
Sixty Tons Per Minute

Baltimore's New Coal Pier, and How It Makes Its Records

By J. F. Springer

WHAT is believed to be the greatest of all coal piers in respect to the rapidity with which coal may be delivered over the side to vessels is the new B. & O. Pier at Curtis Bay, Baltimore. The S.S. "Malden" was loaded at Curtis Bay with 7,222 tons of coal in 118 minutes. This is at the rate of 3,672 tons per hour or 61.2 tons per minute. We have here what is undoubtedly a world's record for fast loading into a single ship. At the same pier, on October 25, 1920, in the space of a 24-hour day, 910 cars, or 41,678 tons, were dumped over the side into various vessels. This is claimed as a second world's record for this pier, which is illustrated on the cover of this issue.

There is no doubt, then, that this new pier at Curtis Bay is a wonderful performer when it comes to handling coal over the side. The coal that comes to the pier naturally arrives by rail from the mines in the mountains far back to the west of Baltimore. A modern coal pier may receive more than it delivers over the side, and it may also deliver over the side more than it receives. The world's record as to the 24-hour period is not clouded, however, by any such fact that the pier received on October 25 less coal than it delivered. As a matter of fact, 49,630 tons were received, or nearly 7,000 tons more than were loaded on to vessels. The possibility of receiving and delivering different amounts is a consequence of the usual provisions for the storage of coal right on the pier itself. Such storage may be in bins or pockets located underneath the deck which carries the railroad tracks belonging to the pier. This is the method adopted in connection with the three tall piers at Hampton Roads, near Norfolk, Va. Or the storage may be provided for otherwise, as at the Curtis Bay pier. Along the Atlantic seaboard are numerous instances of coal piers on whose decks the regulation railroad coal car carries the coal. The three Hampton Roads piers mentioned and the present Baltimore pier are departures from this practice. Standard railroad cars do not go out on the pier. At Hampton Roads the coal is dumped from the standard car into special electrically operated pier cars and these go out on the pier. At Baltimore, this new pier is served neither by a railroad nor a pier car, but by special transporting devices.



General view of the new coal pier of the B. & O. at Baltimore, which puts coal into a single ship at a rate exceeding a ton per second

In all these piers, there are two problems. One relates to getting the coal out on the pier and alongside the ship; the other is concerned with transporting it transversely from the pier to the vessel. At Baltimore, still another requirement was faced. This related to the matter of breakage. When coal is dumped by overturning the railroad car, whether on land prior to transportation on to the pier or on the deck of the pier itself, there is apt to be a good deal of breakage. Some may, perhaps, wonder why, at Baltimore, special efforts should be made to prevent breakage. Baltimore wished to engage in shipping coal to Europe. The European ovens belonging to steam boilers, especially in France, seem, frequently or usually, to be supplied with grates with bars wide apart, the intervals running up to something like 2 or 3 inches. It was desirable, accordingly, to have little or no fine coal in the mass when delivered finally to the factories. In short, if Baltimore was going to enter the foreign business and sell Pittsburgh and Maryland steam coal in such a market, it had to prepare to get the coal from the railroad to the hold of the ship by a kind of personally conducted means of handling to prevent breakage.

Coal coming to the new pier is dumped by two modern car dumpers located a short distance from the land end of the pier. This coal will ordinarily come from a system of side tracks where loaded cars await their turns. The arrangements are such that a locomotive is not needed to take the loaded car to the dumper. This movement is accomplished by gravity. However, this gravity movement continues only to the neighborhood of the dumper, which is actually set at a higher elevation. Up the inclined approach a "barney" is operated by cable to push the loaded car. When the car has come to rest on the cradle of the dumper, it is overturned sideways and the coal dumped into a bin. From this, the coal passes to conveyor belts. These carry the coal out on to the pier deck. It may be delivered to loading towers. These devices are shifted along the pier deck on special tracks and may be halted at any points desired. This provides for stationing the towers exactly opposite the ship hatches. There are four such towers on the pier. There are subordinate conveyor belts mounted in shuttles in the loading towers. These belts run athwart the pier. Their function is to receive coal from the four main belts, which bring it out on the pier, and then make delivery to the sides of the pier. The pier is in fact so located and built as to be usable on either side. The shuttle belts belonging to the loading towers may be made to serve either side of the pier and thus serve ships on both sides.

The foregoing gives briefly the method used at first with this pier when it was being used to take coal from the dumpers and deliver it to ships. This method was, however, found to be something less than ideal, as it failed to put the coal into final position in the ship's hold. The coal had, in fact, to be shoveled back and trimmed by hand labor. It is safe to say that no such world's record as those given at the beginning of this article would have been possible if matters had been left thus. It was seen that some mechanical method was required, by means of which the coal could be put into final position, or at least, into approximately final position. The studies made of the residual problem have been highly successful, as is indicated by the records attained. Otherwise, this great pier 700 feet long, 111 feet wide, having a berthing capacity of four vessels, and costing upward of $2,500,000, would have failed of developing its full possibilities. While the transporting equipment insofar as it deals with the coal along and across the pier, would have been just about as capable as it is now, yet this capacity would have been, in part, useless. In loading ships, it is of no benefit to get the coal to or through the hatch faster than it can be taken away. The development of the new trimming apparatus has changed all this.

To explain this matter a little further, I may direct attention to the fact that where tall piers are used, as at Hampton Roads, where the three giants have decks some 70 or 90 feet above the water, gravity may be utilized to get the coal outboard from the pier. Thus, the coal is delivered by chutes, which may be more or less flexible, from pockets elevated above the tops of the hatches. The gravity action may be utilized to carry the coal to desired positions in the hold. At Baltimore the new pier is a departure from pretty much all American coal piers at tidewater, in that it is a very low structure, with the deck near the water level. Thus, the aid of gravity is pretty well abandoned at the start. To get the coal to its proper and final positions, mechanical effort must be brought in.

The new trimmers are four in number, one to each loading tower. They are suspended from booms, and the booms are set up on the tower superstructures. They are directly above the shuttle belts which receive coal from the main belts and convey it athwart the pier, as already described. When a trimmer is to be put into service, it is placed at the outboard end of the shuttle. The coal drops from the shuttle belt into a telescopic chute which delivers it to a curved steel plate. The plate delivers, in turn, to a rapid endless belt. This belt is a small one, but its rapidity of movement is very considerable, being 37½ feet per second. The coal is by this belt thrown to whatever nearby points are desired. The curvature of the steel plate which delivers to the rapid belt serves to prevent the coal from striking the belt with too much suddenness. It is said that the effect is to "cushion" the impact upon the belt and permit a steady stream to be delivered to the belt "without any breakage."

An operator is employed to control the trimming operation. He is provided with a cab at the bottom of the telescope chute and to one side of it. The apparatus may be shifted around through 360 degrees, so that all directions are within its scope. The rapid belt which does the trimming may be adjusted as to the angle at which it effects its throw. This enables the operator to control the distance. In order to get the greatest throw, the lip of the trimmer belt is elevated to its maximum height. As the need for shorter and shorter throws develops as the coal piles up at the distant points, the lip is more and more depressed. This change is made gradually, under ordinary circumstances. It has been found possible to throw coal a distance of 45 feet. The arrangements connecting the belt with the telescopic chute are such that the trimming belt may be dropped so as to be clear of the chute. This permits the chute to deliver directly to the pile in the hold.

The maximum reach of the trimmer belt from the side of the pier is 35 feet. It may be lowered to a maximum of 48 feet below the shuttle belt. The telescopic chute may be extended to a great length—as much, in fact, as 52½ feet. It may be shortened up to various lengths through a range of 21 feet. This leaves the minimum length 31½ feet. This variability of length permits serving various decks of the miscellaneous types of vessel which come to the pier. The

(*Continued on page 480*)

Valuable Binder Material from Waste

By George H. Dacy

AFTER 26 years of investigation and research, Mr. T. B. Mohler of San Francisco has discovered a process of renovating a valuable binding material from such waste products as city garbage, rice screenings, miscellaneous tailings and aftermaths. The range of uses to which the new material may be put is so wide that its appearance on the world market will affect many industries. Its efficiency and its extremely low cost of production are outstanding features of the new product.

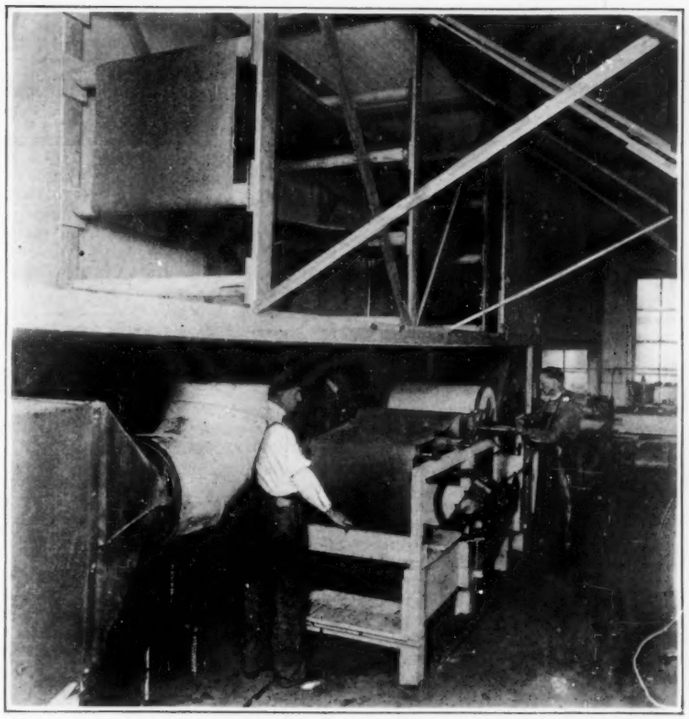
The reclamation system which features the salvage of valuable adhesives from garbage and other refuse is relatively simple and does not involve the employment of special-purpose machinery nor the mobilization of costly and intricate equipment. Ordinary city garbage—rich in cellulose and animal matter—which has been accorded selection and examination to remove deleterious foreign material is reduced to a liquor form as a consequence of passage through automatic grinding machinery and subsequent exposition to centrifugal filtration. The dry cake or solid residue from these operations is used as a base for the manufacture of agricultural fertilizers. Although this cake is a by-product it is a valuable material which is so useful and of such intrinsic worth for farming uses, that the profits resulting from its reclamation alone would be adequate to justify the municipal collection of garbage and its reduction in order to obtain this fertilizing material.

The liquor which obtains from the filtration process, however, is the article upon which Mr. Mohler has been working so long. By a special method of fermentation, this liquor is converted into the desired binder. It can then be dehydrated and prepared for shipment in a crystalline form if the intention is to transport it long distances before utilizing it in the industries. On the other hand, if it is to be employed for manufacturing purposes directly in the plant where it is extracted, it can be used at once in the liquid form.

The fluid binder is a pure white liquid which will not discolor the most delicate fabric or cloth nor will it in any respect injure associated materials or coloring matter used in dying these fabrics. It is admirably adapted for the binding material to be used in the manufacture of coal briquets, the cost of the binder being but thirty cents per ton of fuel, as against current conditions of coal briquet manufacture, which feature the use of binding materials costing from $2.75 to $3 a ton. Laboratory, manufacturing-plant and private-home tests of briquets using the new binder demonstrate that they are clean, exude no disagreeable odors, can be handled readily without breakage, burn without fracture or disintegration to a clean, light ash and admit of the full derivation of the heating value of the fuel.

One of the interesting results attained by Mr. Mohler was the discovery that when his binder is combined with certain oils, it forms an emulsion which when applied to fabrics renders them waterproof and acid-proof. Again, this process like that of the coal briquet production is simple and inexpensive. Any material from the heaviest cotton to the finest silk can be treated in this manner without in any way changing its softness or flexibility of texture and without cracking or otherwise damaging the goods. The tendency of the treatment is to strengthen and increase the longevity of the materials. The cost of treatment ranges from two to eight cents a yard depending on the quality of the goods and the grade of the binder which is used.

It has been proved conclusively that the new binder is particularly adapted for the manufacture of raincoats, high grade mackintoshes, gossamers, oil clothing, sportsmen's coats, suiting, oil silk, dress shields, medical silk, wall decoration, tenting, awning, ship decking, unbreakable oil cloth, imitation leather, linoleum, chemist's aprons and waterproof sacking. The processes involved are incredibly cheap and yet are productive of goods which surpass the others in durability and wearing qualities. A special feature of all these products is that they are non-inflammable.



Machine used in the laboratory for water-proofing fabrics with material recovered from wastes, and subsequently drying them on rolls by means of hot air from the furnace

In all communities where rice mills are operated, the accumulation of rice hulls, by-products of the preparation of rice for commercial uses, is becoming a menace. These hulls cannot be burned nor carried out to sea and dumped. They can now be used for the manufacture of powerful and durable insulating materials which obtain from the proper mixture and processing of rice hulls, diatomaceous earth and the new binder. High quality wall board, box shook, toys, and unbreakable dolls may be made in this way. Powdered asbestos and silica mixed with the binder sticks to boilers and pipes so tenaciously that only a very heavy blow from a hammer will loosen it, and is not affected by either heat or cold. Superior, non-inflammable water-proof and acid-proof paper can be made by treating ordinary grades of paper with this material. This also applies to cartons and containers. One of the most unusual tests, which goes to show the great adhesive properties of this new material, is that it will bind powdered pumice, one of the most difficult substances known to hold together. Test blocks made in this way have, subsequently, been subjected to tremendous heat even up to fusing point without any evidence of fracture or injury.

Different kinds of building materials are made from the new binder combined with waste paper and straw. Boards of all sizes and dimensions can be made and, subsequently, can be sawed, planed, nailed and glued exactly like ordinary lumber. Sound-proofing, heat-insulating and refrigerator-car insulation are made from straw, sawdust and waste paper, while wall board is manufactured from rice hulls and the binder, and other valuable articles are made from old leather and findings.

In order to obtain the base material for the extraction of the binder used in combination with the heavier and coarser fabrics and other materials, a special garbage disposal system had to be provided. A method has been devised which admits of handling the city refuse in units of 50

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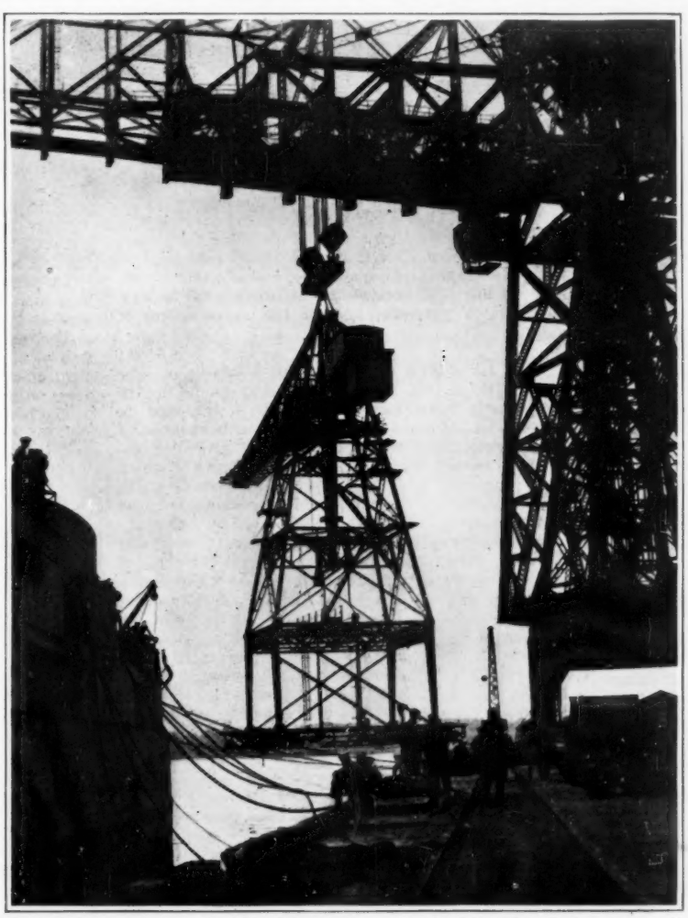


The 4,000-ton crane at the Philadelphia Navy Yard lifting the 300-ton "pygmy"

Giant Crane Lifts Its Smaller Brother

THE Philadelphia Navy Yard boasts of the most powerful crane in existence. It can lift 350 tons at a distance of 115 feet out from its tower, and 50 tons on a reach of 190 feet. In its test for acceptance it lifted a maximum load of 490 tons. Its extreme height is 230 feet. The rotating part of the crane, with its maximum load, weighs 2,917 tons, and the total weight of the whole crane as it rests upon its pile foundations is 4,000 tons. A gigantic structure in very truth.

Recently there was constructed at the outer end of the pier on which the big crane stands a smaller crane of the traveling type. It was built at the outer end of the pier for convenience, and after completion it had to be moved past the big crane, so that it might operate on the shore end of the pier. How to make this transfer was the problem, until someone suggested that, since the yard possessed a crane of sufficient power and reach to lift the smaller crane bodily, it would be a good plan to lift the little fellow up bodily, swing it around over the water, and place it again on the pier in the required position—which was done. We hear much in these days about relativity, and in the present case, although the lifted crane was small in comparison to its big brother, it weighed no less than 310 tons. Many of us can hark back to the day when a 310-ton crane would have been spoken of as "mammoth" or "giant."

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

A Compilation of American Dye Patents in Abstract Form

THE Color Investigation Laboratory of the Bureau of Chemistry, Department of Agriculture, announces that a compilation of Amer. an dye patents in abstract form is available for consultation by those who may care to call at the Laboratory and that information can also be secured by mail addressing the Laboratory and for the attention of Joseph Ambler, Acting Chemist in Charge. Each patent has been abstracted under the following seven heads:

1. Scientific names, when known or given in the patent.
2. Intermediates used, with a very condensed statement of the method of manufacture.
3. Class of dye, according to Schultz's eighteen chemical classes.
4. Color of dye.
5. Method of use.
6. Fiber or material for which suitable.
7. Name of owner, and, in parenthesis, name of patentee.

The abstract has been placed upon 3 by 5 cards and a separate file has been set up for each of the seven headings. These are completely cross-indexed and the patents may be quickly located according to the interest of the investigators. These abstracts do not do away with consulting the patents themselves but they do constitute what is probably the best index that has been devised for them, and are sufficiently complete so that the user can decide at once whether the patent in question is one which he must consult or can eliminate from his consideration.

Jute

IN the *Color Trade Journal* for April are a few paragraphs under "The Dyeing of Jute," which indicate the properties of the fiber as well as satisfactory methods for dyeing it.

The jute is contained in the wood of the plant and is freed from the woody tissue by the retting process very much as linen is secured from flax. It is longer and coarser than cotton and has great strength and durability when spun in a coarse yarn. On account of these properties jute is largely used in the manufacture of carpets, in cheap portieres, various types of covering, and rugs. It absorbs dampness and retains it and, therefore, deteriorates much quicker than many other vegetable fabrics. Carpets with an under weave of jute should be kept in dry storage and if used where dampness prevails these carpets should be impregnated with alum which has proved quite successful in preserving the fiber. Although a vegetable fiber, jute has a marked affinity for dyestuffs. When treated with chlorine and sodium nitrite a red color characteristic of tannin is produced. This tannin-like material in jute accounts for its absorption of basic colors in the same manner as mordanted cotton. Jute in the carpet mills is ordinarily dyed with direct colors which are fairly fast. Substantive colors dye jute without any addition to the dye bath. Basic colors are dyed without previously mordanting the goods and where very bright red and blue are desired some acid dyes may be used.

Synthetic Resins

IN the April 13th issue of *Chemical and Metallurgical Engineering*, synthetic r sins from furfural are discussed, this being a continuation of work at the Bureau of Chemistry growing out of an attempt to utilize corn cob products. With the prospect of furfural becoming one of the chief organic chemicals, research, looking to commercial uses of this material, has been undertaken and the work reported is a preliminary one on the possibility of preparing synthetic resins. The experiments are described in some detail and the following general properties are given:

"The resins do not have sharp fusion points, softening gradually till fluid. The softening temperatures of the resins made as described lie between 25 and 100 deg. Cent., but have not been carefully determined, since the softening point can be raised to almost any reasonable temperature desired by simply heating the resins at higher temperatures or for a longer period of time.

"All of the above resins are practically insoluble in water. They are somewhat soluble in turpentine, quite soluble in benzene, acetone and alcohol, and very soluble in furfural. The acetone, benzene and furfural solutions of these resins form varnish stains which, when applied to wood, give shades ranging from golden brown to black, depending upon the resin, the concentration of the solution and the number of coats applied. The surfaces thus coated have a glossy appearance."

In all, eight resins have been produced for experimental purposes and when applied to white oak these give various shades of brown from the lightest when applied in a solution of benzene to one which is nearly black in a solution of furfural.

The Fineness of Calcined Gypsum

THE April *Journal of the American Ceramics Society* contains an article on the relation between fineness and other properties of calcined gypsum. The experimental methods are described and the data indicate that a normal constituency is obtained with less water the coarser the gypsum and that the time of set is shortened with increased fineness of the material. The finer the calcined gypsum the stronger is the set material until the degree of fineness goes beyond that of size 6 as defined in the specifications of the American Society for Testing Materials. If the fineness is carried beyond this point there is a decrease in strength although the finer the calcined gypsum the more sand can be carried by it. The authors state that their results are not based on a sufficient quantity of data to warrant the above conclusions being called more than indications and propose to continue their work.

Sweet Potato Syrup

DR. H. C. GORE of the Bureau of Chemistry, U. S. Department of Agriculture, has been experimenting for some time with sweet potatoes as a source of syrup, the intention being primarily to provide an economical outlet for the considerable portion of the crop that may not be marketable as well as to establish an industry which would assist in the diversification of agriculture in the Southern States. The Department has now decided to establish a production unit or demonstration at Fitzgerald, Georgia, where questions of cost of commercial production as well as the market value of sweet potato syrup as compared with syrup from corn, cane, malt, etc., can be determined. Production is to be undertaken as soon as machinery can be installed and if this large scale experiment proves successful the commercial manufacture of sweet potato syrup may be undertaken. Samples thus far produced are rich in sugar, highly palatable, and of a fine brown color. It has been used with satisfaction for baking, general table purposes, and in the manufacture of candy.

Research in Glass Containers

CONSIDERABLE progress is being made in the research laboratory established in Chicago to study the use of glass as a container in new fields of canning, preserving and bottling. The present problems have to do with determining the pressures which can be practically withstood, the best methods of sterilizing the materials canned in glass, precautions to be taken in packing to withstand transportation, and methods of improving glass containers so that they will withstand destructive agencies. The advantages of seeing the contents both during the period of processing and storing and at the time of sale very greatly offset any disadvantage that may be due to character of the container. It has also been argued that a glass container makes it far more difficult for inferior materials to be used. There are many problems still to be undertaken as soon as the organization has been completed and the work preliminary to the establishment of such a research laboratory completed.

Dyeing in an All Wool Suit

DR. L. J. MATOS in *Drug and Chemical Market* gives the following interesting data with respect to the cost of dye in an all wool suit. This is quoted here in the hope that it may convey more accurately information to those who seem afraid that American dye manufacturers because of higher costs in this country wish to establish an industry at a cost which will prove excessive to the users of fabrics.

"For each pound of cloth there will be required from 3 to 4.64 pounds of wool in the grease (average of 3.73 pounds) or 1.37 pounds on the scoured basis. Assuming that the average suit for a man will require 3¾ yards of 54-inch goods, this will weigh about 5.13 pounds or 82.08 ounces.

"The amount of dye that is necessary to color this cloth properly will vary to a certain extent, but will be, for black, about 6 or 7 per cent or 6½ ounces of dye. For navy blues the dye will be about 3½ per cent or 2.87 ounces, while for fancy shades, 3 per cent of dye will suffice, or 2.46 ounces.

"Assuming the cost of black dye for wool at $1.35 the cost per ounce is 8.42 cents which gives an actual dye cost per suit of 48.4 cents. The average cost of chrome blue is $3.03 per pound or 19 cents per ounce. This gives the cost per suit of 54.53 cents while wool dyes for fancies average $1.25 per pound or 7.77 cents per ounce, giving a dye cost per suit of 19.11 cents.

"From the foregoing it is obvious that the cost of dye per suit is one of the items of least cost, and might well be compared with the cost of the buttons generally used.

"Nothing but the actual cost of the dye has been included in the above, and the cost of labor, steam and other chemicals has not been considered. At a very liberal estimate, however, this would not amount to the cost of the dyestuffs used. Even assuming that this would be the case, the total cost of dye and dyeing actually used on the cloth for a suit would only average 86.71 cents for all shades, from 'fancies' to 'blacks.'"

Smoke Screens

HUGE clouds of black or white smoke employed to hide the movements of ships at sea and troops by land were evolved from small quantities of material, according to information which is now published for the first time.

Some of the secrets as revealed by Dr. George D. Richter in an article in the current number of the *Journal of Industrial and Engineering Chemistry*, indicate that had the European War continued, the making of smoke screens would have become a fine art.

The Chemical Warfare Service had a combustion chamber at the American University Experiment Station, Washington, D. C., in which various smoke-making mixtures were burned and density of the vapor studied by ascertaining how much it obscured the rays of electric lights placed in the midst of it. Thus the various mixtures were measured according to their "T. O. P.," which means "total obscuring power" in its full form.

By permission of the Chemical Warfare Service, the formulæ of the substance used in creating smoke screens is made public.

The material which showed the most promise is known as the "B. M." mixture because it was originated at the United States Bureau of Mines in a crude form, although it was perfected later by the Service.

The proportions in the following representative formula were varied somewhat, depending on the method and the form of device in which the smoke was used:

	Parts
Zinc	35.4
Carbon tetrachloride	41.6
Sodium chlorate	9.3
Ammonium chloride	5.4
Magnesium carbonate	8.3

Testing Lubricating Oils

THE Agricultural and Mechanical College of Texas has started experiments in the chemical engineering and agricultural engineering departments to determine the properties of lubricating oils and to determine the qualities that suit them for use in various types of internal combustion engines. Asphaltic and paraphinic base oils are the principal ones under consideration and several manufacturers have contributed samples of their products for the tests. Automobile and tractor manufacturers have supplied different types of engines and it is proposed to subject the different oils in question to practical tests in these engines. The physical and chemical qualities of the oils will be determined before and after test and an effort will be made to establish relations between the laboratory tests and a practical value of the oil as shown by the motor experiments.

How Japanese Dwarf Trees Are Raised

THE little Japanese trees exhibited in the windows of the better grade Japanese novelty shops never fail to excite considerable interest, because they are so unusual. In fact, in Japanese horticulture the art of landscape gardening on a miniature scale plays an important, if not a leading rôle. A village or a single home, surrounded by beautiful country, will be formed within a plot of ground a few yards square by the Japanese artisans. A river with its bridges, a lake with tiny ships on its silvery surface, roads, gardens, fields—all these features are to be found in the more pretentious Japanese miniature works. Hence it is not surprising to learn that the Japanese, in order to carry out their miniature landscape gardening with the utmost realism and fidelity, have had to raise dwarf trees for this purpose.

So the custom of dwarf trees has become an established one in Japan, some of these trees attaining the age of 200 years. The whole system of culture of these tiny trees may be summed up as the reversal of nature's method. It really consists not in the survival of the fittest, but rather in the survival of the unfittest, so to speak. A poor, weak seed is usually chosen and planted. As soon as it has attained some growth, the leading shoot is trimmed off. The little plant then grows two other shoots, and these are carefully watched. When one shoot exhibits a strength that is vitally greater than its fellow, it is at once cut off and the weaker shoot left untouched in order to form the future dwarf tree's main stem or trunk. This system of trimming and cutting is followed punctiliously. Water is seldom used—only in such small quantities as to keep the little plant actually alive. The tree is kept in a pot too small for its full development and the roots are constantly pruned. The shoots are carefully trained and bent to follow the growth of a large tree.

All of which, it goes without saying, requires great patience; but this is a commodity with which the sons of Nippon are endowed to a degree approached by few of the Caucasian races, and the Japanese horticulturist never tires of watching the growth of his tiny trees. When such a tree has been growing for about five years, it can be left to take care of itself, since it has become accustomed through its training to follow the rigid course laid out for it, and can then be trusted not to strike out again in the pursuit of its natural size and vigor. In this manner magnificent specimens of dwarf trees are produced which compare favorably with anything found among their big brothers in the untrained forests of Japan.

All Photos. Copyright, Keystone View Co.

Chabo miniature trees and how they are trained to grow around rocks

Meteor Observers in Czecho-Slovakia

A CENTRAL office for collecting reports of meteor observations in Czecho-Slovakia was established in May, 1920, at Reichenberg, Bohemia, by Arthur Beer. A noteworthy feature of this undertaking is that fourteen branch stations have been established in different parts of the country for the purpose of gathering information regarding casual observations of meteors, as distinguished from those made by regular observers.

Miniature Japanese trees of the Chabo variety, with their roots exposed

The Current Scientific American Monthly

THE June issue of the SCIENTIFIC AMERICAN MONTHLY will be found a valuable supplement to the last few numbers of the SCIENTIFIC AMERICAN. The number opens with an important contribution by Prof. Charles Lane Poor, who outlines a possible alternative to the Einstein Theories of Relativity that would save the Newtonian law. A discussion of this interesting paper appears on page 468. The article on the Roger Bacon Manuscript, which was published in last week's issue of the SCIENTIFIC AMERICAN, is supplemented by a more lengthy paper on this subject, outlining the history of the manuscript and efforts to decipher it; while an exceedingly interesting account of Egyptian life 4,000 years ago, describing the recent discoveries on the west bank at Thebes, supplements the article entitled "Looking Backward 4,000 Years," which appeared in our issue of May 7th.

"Visual Illusions in the Arts" is the title of an article by M. Luckiesh, which gives an account of tricks of lighting, color and form, which are employed by painters, sculptors and architects.

Under the title "Chemical War on Disease," Dr. H. Schwarz gives a popular explanation of the action of certain chemicals on the toxins that are responsible for infectious diseases.

Prof. L. A. Hausman of Cornell University tells how the microscope may be used for the analysis of various foods. By this means it is possible to detect adulterants.

"Flavors, Odors and Infra-red Rays" is the title of an article describing the recent work of M. Charles Henry, who has discovered a relation between taste and odor and infra-red rays, and has thus been enabled to obtain perfumes which are far superior to ordinary ones, both in intensity and in delicacy.

An account of Jean Perrin's brilliant new theory to the effect that chemical energy is a direct result of the wave length of the various rays found in the visible and invisible spectrum, is written very lucidly and in a form that will appeal to the layman.

A special chair of experimental phonetics has just been established at the College de France for the distinguished priest, Abbe Jean Rousselot, who is now in his 75th year. M. Rousselot has been studying the production, perception and analysis of sounds all his life. An account of his work and the interesting apparatus he employs is published under the title "Experimental Phonetics."

One of the industries that suffered from lack of raw materials during the war was that of manufacturing

(*Continued on page 480*)

A Chabo tree about 100 years old

Pine dwarf tree. Note odd form of roots

Japanese garden, showing dwarf tree

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

The line-carrying buoy that drives ashore before the wind with its cargo of rope being paid out

Blowing a Line Ashore from a Wreck

WRECKS on rocky shores, reasoned W. S. Crouch of New York, occur when the wind is on shore. He sought to take advantage of this fact in devising some means for getting a line from ship to land—the operation which usually takes so much time and is so fraught with peril. The line-carrying buoy which we illustrate is the result of his work. The buoy was recently tested at Rockaway Beach and did all that its inventor asked of it. Released from the ship, it blew steadily toward shore, the line unwinding behind it as it went, until finally it was dragged out of the surf with the line intact. In addition to its use in this manner, it is available for all the regular purposes of the ordinary buoy.

The Universal Angler

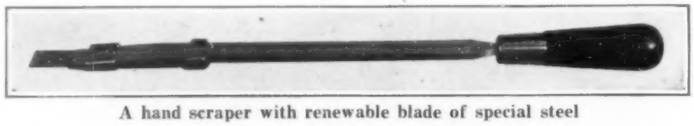
THE carpenter to a greater degree than any other mechanic is dependent upon squares, bevels, etc., but every mechanic has to use them a good deal. We illustrate herewith a little tool which is designed with the intention that it shall be all squares in one. It is got up so that all the ordinary angles, 30, 60, 45, 90 degrees, etc., can easily be located on it and it can be used with pencil, ruler, etc. It may be used as a scratch gage, a depth-gage, an inside square, a gage for transferring measurements, a plumb-gage, etc., with the utmost convenience. The pattern of lines and circles which we show was made with a single setting of the ruler in the gage. The tool is of aluminum, light and of handy size.

Tractor Hauls Wood Economically

AN excelsior manufacturer of Boston has a factory at Derby Junction in the wilds of Maine and the use of a small track-laying tractor made it possible for the plant to keep going at top speed during the roughest winter that wintry Maine has known. The tractor hauls a seven-cord load of spool wood on two big sleighs from the woods to the factory, a distance of 7½ miles, twice a day, no matter what the weather conditions. Horses, when they were not held up by snow drifts, were able to make three trips in two days. The horses would make the journey to and from the lumber camp and then return to the lumber camp, remaining over night. The following day they would bring in a load and make another journey in each direction. In addition to coping with weather which would make the horses useless the tractor made four trips in the time the horses would make three, this extra load of seven cords being a big factor in speeding up production.

The Handy Hand-Scraper

RATHER well designed is the hand scraper which we illustrate herewith. The blades are of a quality not often met in scrapers, and will last as long as four ordinary hand-forged scraper blades. Nevertheless, admirable provision is made for replacing them when they do wear out, as will be seen in our picture. The clip is notched on the inside to receive the blade, and holds it positively in place; and the blade carries a lug on its rear end, which not alone prevents the blade from slipping back but which also causes the clip to tighten automatically when pressure is applied. The blades are supplied ready for use, so that no time is lost in forging them.



A hand scraper with renewable blade of special steel

A New Taper Pin Reamer

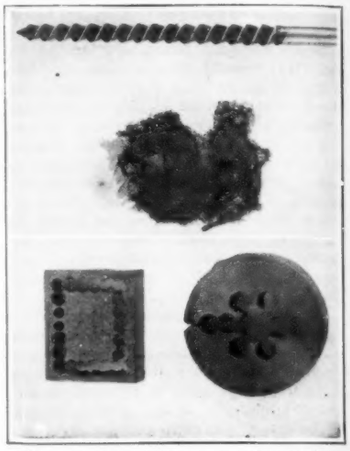
A TOOL designed for reaming holes for taper pins rapidly and accurately has been introduced by a Connecticut manufacturer. It is claimed that this new tool will ream holes in any metal at least three times as fast as a fluted reamer. It is designed to be used in a drill press as well as electric or air drill. For die making holes are drilled close together and by enlarging the holes with this reamer the metal between the holes can be rapidly removed. At one operation an opening of any desired shape may be cut out and proper clearance is provided.—By *Allen P. Child.*

A Railroad Motor Car

A STANDARD motor car adapted for use on railroads by fitting special trucks is well suited for service as a private car, and could be used profitably on non-paying roads where the traffic does not call for the frequent service of heavy steam locomotives. A car of this kind has been built and patented by J. F. Kehrman, master mechanic of the Mississippi River & Bonne Terre Railway, at Bonne Terre, Mo. The general dimensions and features of the car are:

Cylinders, six; diameter 3¾ in. by 5 in. stroke. Total wheel-base, 10 ft. 8 in.; rigid, 3 ft. Swivel truck, 4 wheels, ball-bearing center plate, no arch brace, truck built with studs. Air pump attached to crankshaft, and air-brakes on all wheels. Equipped with whistle signal, horn, air sanders and air drums attached to running board, 2½ cu. ft. capacity. Also equipped with hand brake on front truck operated by steering wheel. Tires of open hearth steel flanges and taper—master mechanics' specifications. The car operates on 60 deg. curves, and is rated at 40 m.p.h.

The consumption of gasoline is about one gallon for 20 miles. In a trip of 63 miles over the Mississippi and Bonne Terre Railway, which portion is on a 1.8 grade with 10 to 12 deg. curves, the motor carrying seven passengers, three gallons of gasoline were used. Weather tops are being applied to the cars already in service which adds greatly to their appearance.

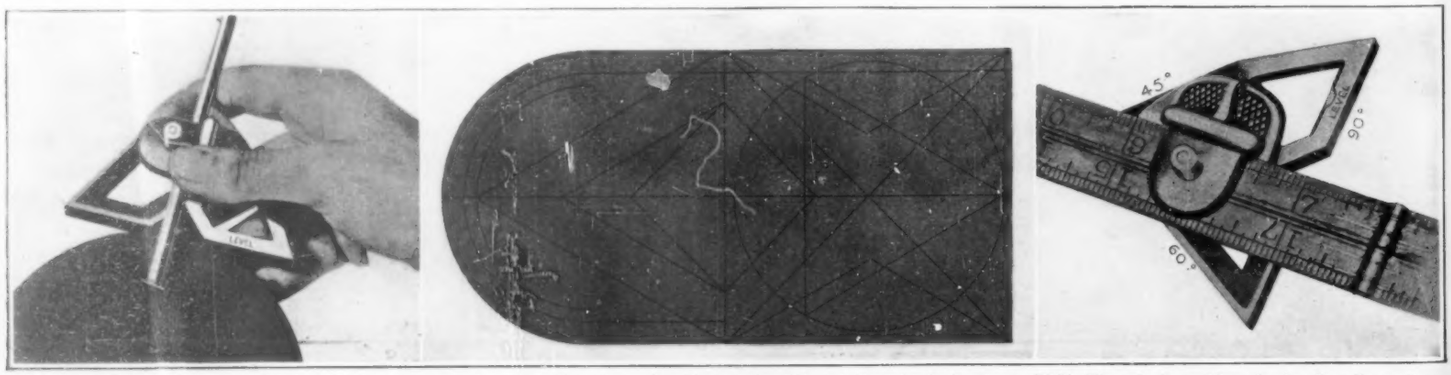


The new taper-pin reamer (top) the sort of work it will do (bottom) and the chips that it produces (center)

Recent Patent Decisions

Effective Anticipation.—The plaintiff in this case was the owner of letters patent relating to a method of delineating or reproducing pictures and designs, and seeks to enjoin an alleged infringement on the part of the defendants. The defendants set up three defenses—1, that the invention is without patentable novelty and is not the product of the inventive faculty in view of the prior state of the art. 2. That the subject matter of the patent was the conception of one only of the three inventors. 3. That the methods which the defendants employ in doing their work are not comprised by the patent as is shown by the file wrapper, and therefore there is no infringement.

Plaintiff's patent is for a process whereby multi-color pictures, having an embossed effect, are produced. The method of production is by use of a screen consisting of bolting cloth or other material through which coloring substances, such as paints and the like, are forced by pressure applied by means of a scraper, or what is termed as a squeegee, upon the background or surface upon which the picture is produced. An outline of the picture is first provided, according to the colors of which it is designed to be composed. The background or surface is given a base color which covers the whole of it, such as green, for instance. Such portions of



Left: The tool in use as a scratch-gage. *Center:* A pattern of angles and circles made with a single setting of the ruler in the gage. *Right:* The rule in position, showing how the various angles are obtained with one setting

The handy angler that takes the place of a dozen squares and bevels

the base color as are designed to be retained and form a shade in the picture are then traced out upon the screen, and blocked or stopped out, as it is termed, by the use of shellac or some substance that is impermeable by the paint or other coloring matter. The screen is then applied to the background, and the second color, such as blue, for instance, is pressed through the screen by the use of the squeegee upon the background—the second color overlaying the first, except such of the first as has been blocked out on the screen. The blocking-out process and the application of colors are repeated in the same way until all the colors of the design are produced upon the picture. The result is that each subsequent color overlays some portion of the previous colors, so that the last color applied always overlays in some area all the previous colors. Thus is produced a picture having an embossed effect, very attractive to the vision, especially when oil paints are used of such viscous consistency as to give such sensible thickness to the succeeding layers as to form plateaus of color. The screen, being stretched upon a frame, is so hinged upon or adjusted to another frame as to give exact register in outline of colors, as well as exact register of the weave of the screen's fabric, upon each succeeding imprint.

The court found that the plaintiff's patent was not anticipated and was valid. The point of law adduced is that, to be effective as an anticipation, a patent must be so clear and definite as to enable any mechanic skilled in the art to reach the patented invention certainly, directly, and without the necessity of experiment—and this rule is enforced with particular strictness when applied to a foreign patent. Where infringement is charged, the burden of proof is cast upon the defendant to establish anticipation beyond a reasonable doubt.—*Selectasine Patents Co. v. Prest-O-Graph Co. 267 Fed., 840.*

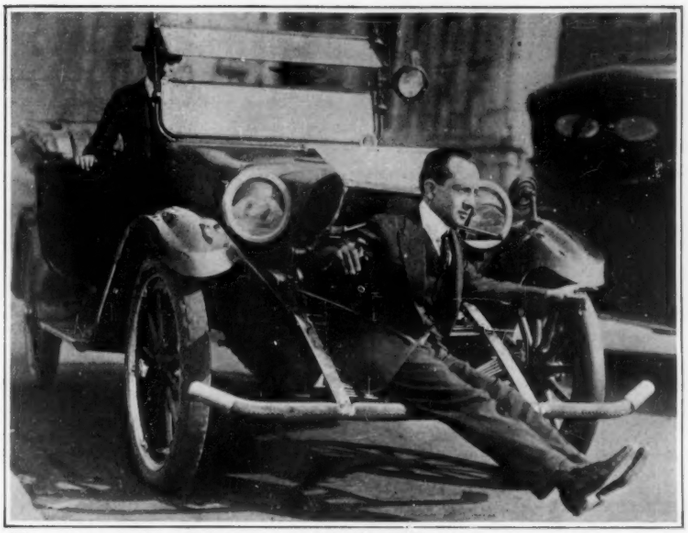
The Police Fort

PERHAPS the newspapers exaggerate when they employ the expression "crime wave." Perhaps there are no more bold crimes of violence today than there were twenty years ago, the different impression that we get being due merely to greater publicity. Or perhaps, taking a less extreme view, the difference is due merely to the superior operating facilities which the automobile and other modern inventions have given the criminal.

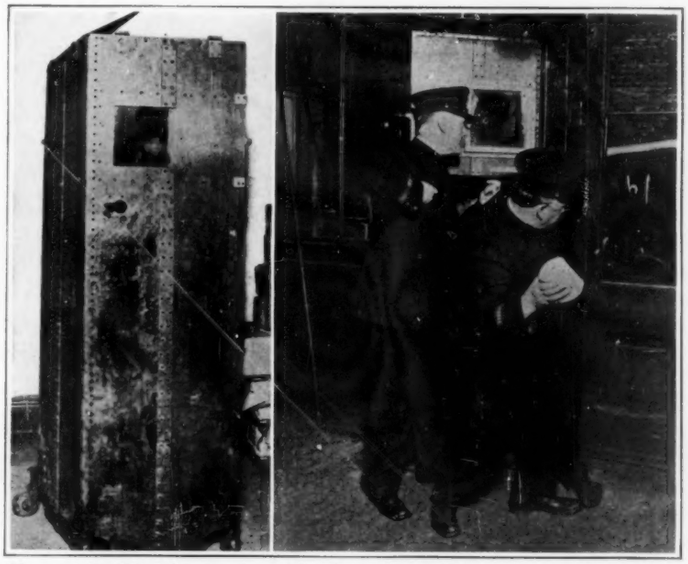
A glance at the accompanying photographs, showing the latest aid to the enforcement of law and order by the Chicago police, ought however to be sufficient to make the most skeptical person realize that we are "confronted by a condition, not a theory." It seems that the Chicago cop is at such a disadvantage in his efforts to cope with the highwayman along conventional lines that it has been necessary to furnish him with a portable fort. This consists of a screen of bullet-proof steel, some ten feet high and four feet wide. It is made up of two panels, two feet each, firmly hinged to one another. Mobility is attained by the simple expedient of attaching casters—casters just like those under the dining room table, only more so. This miniature block house can be used by a single guardian of the peace, or by two—though in the latter event it seems that it will provide somewhat crowded quarters.

Saving the Pedestrian

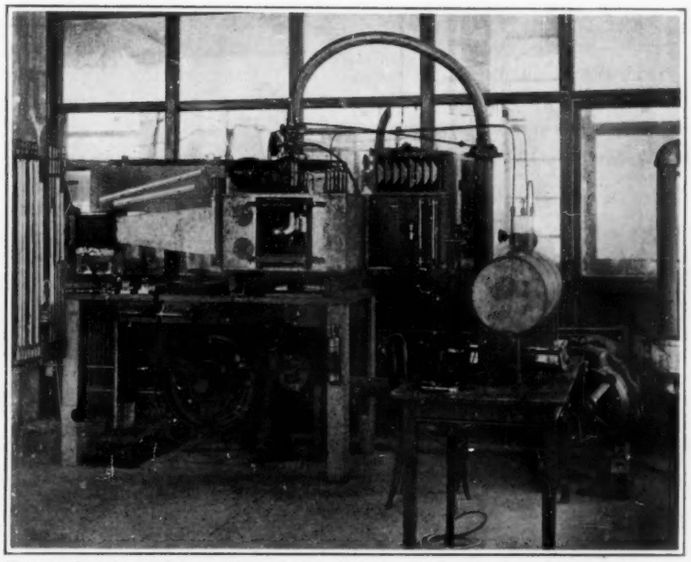
NUMEROUS inventors have put forward safety fenders for automobiles, designed to catch up the unwary pedestrian who gets in the path of destruction, and prevent him from being thrown under the wheels of the car. Numerous of these inventions were entirely satisfactory



The safety fender that does not mar the lines of the car yet picks up the pedestrian who gets in the way of the automobile



The portable block-house adopted by the police of Chicago, as used by a single officer and by two



The carburetor testing plant of the Bureau of Standards, which determines the proper atmospheric pressure for a carburetor as well as the best temperature

so far as their mere working was concerned; but they have almost without exception been open to the fatal objection that a car equipped with one of them would look like a cross between a folding bed and a portable concrete mixer. In the eye of every motorist it is the other fellow who is the reckless driver, and who is responsible for whatever of disrepute the man at the wheel suffers. And no motorist is willingly going to attach to the front of his car any device that disfigures it to the extent that it would be disfigured by the huge sweepers, nets and swinging arms that have featured most of the pedestrian-saving apparatus that we have seen.

We must, however, recognize the device pictured on this page as decidedly different from the usual run of safety fenders. Every car carries a fender, to begin with, argues Mr. E. Finelli of New York, the inventor; and if a safety device could be incorporated in the fender in such a way as to violate in no way the lines of this attachment, there would be no objection to its use. The photograph indicates the extent to which he has succeeded in making his safety fender architecturally a part of the car. In the demonstration which our photographer has caught, the inventor himself played the part of "victim," and so great was his confidence in his fender that he allowed himself to be struck by a car moving at 25 miles per hour. Except for the shaking up natural in such a collision, he escaped without the slightest damage.

The fender can be attached to any make of car. It weighs but 75 pounds.

Have You the Right Mixture?

A SPECIAL carburetor test plant, developed by the National Bureau of Standards under the exigencies of war, is applicable in determining the efficiency of air-craft apparatus in times of peace. So if your carburetor acts strangely and refuses to yield to customary treatment, bundle the unruly mechanism and address it to the Bureau of Standards, Washington, D. C.

It may be that the aviator is unable to determine accurately the ratio of air to fuel under various service conditions. That is one of the chief functions of this Government experimental plant. The plant was designed for handy, speedy and definite observations relating to carburetor performance, without including the complications incident to engine behavior in such testing.

The machinery for testing the carburetors is comprised of something made like a mouth or opening air meter, supplying air to small altitude chamber, in which the carburetor is mounted. Air is forced through the carburetor by a vacuum pump, the flow pulsations in the air stream being simulated by an apparatus controlling both rate and amplitude of the pulsations.

Pressure within the carburetor chamber can be lowered from that of the atmosphere to about one-quarter of an atmosphere; moreover, the air temperature can be raised to any desired value above that of the atmosphere. Perhaps your carburetor is operating at a tremendous loss of motion—then, this test plant can indicate methods whereby maximum convenience and a minimum of cost and lost motion are possible.

Experiments in this aeronautic power plant have proved the capacity of the Bureau of Standards for reproducing substantially any condition which may obtain in service on an engine; and yet variables due to the engine condition are eliminated. Weighing of the fuel, observations of pressures about a carburetor which permit of determining the mixture ratios, and the coefficients of flow under any air-craft service conditions—these are the functions of the test plant, operated by one man.

Recently Patented Inventions

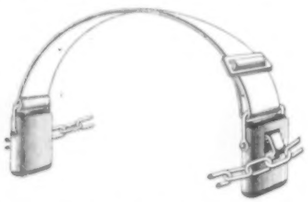
Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Electrical Devices

SEPARATOR FOR STORAGE BATTERIES.—W. BEST, 404 E. 10th St., Kansas City, Mo. An object of the invention is to provide a separator of slate, located between the plates of the storage battery, which will be acid proof and a perfect insulator which will withstand enormous heat without deterioration and which will last indefinitely with ordinary care.

Of Interest to Farmers

BACKBAND.—J. B. MCHUGH, P. O. Box 16, Zachary, La. Among the objects of the invention is to provide a backband for draft animals which will be comfortable to wear and which will be readily adjustable to animals



A PERSPECTIVE VIEW OF BACKBAND WITH TRACE CHAINS CONNECTED

of different sizes. A further object is to provide means for securing the trace chains to the backband and to provide a backband which will be strong and durable.

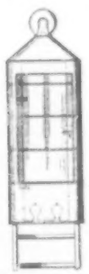
MOUNT FOR PLOWS AND OTHER TOOLS.—E. DUNLAP, Diamond Springs, Cal. The invention has for its object to provide a gang plow supported on one wheel which may be turned or swung around relatively to the tractor or draft-member. This connection of the plow with the draft-member makes it possible for the plow to be turned around among trees and it is also possible when the plow shares are suspended to back the plow into corners. In this way the plow may be operated anywhere the tractor may go, on very small lots as well as large fields.

AUTOMATIC RELEASE.—E. D. PEPPER, Pickens, Miss. An object of the invention is to provide a device which is especially adapted for use with plows, and so constructed that when the plow strikes an immovable obstruction in the ground the draft means will be automatically unhitched from the plow. The device may be used either with horse or tractor drawn plows.

Of General Interest

FILING DEVICE.—A. C. BARNARD and W. O. BANKS, Oakland, Cal. This invention relates primarily to filing devices and the like which are generally used in office equipment and has reference more particularly to a device for conveniently filing documents or data such as railroad or steamship freight and passenger tariff publications, which require considerable handling. The equipment can be manufactured and sold at a comparatively modest cost.

POPCORN HOLDER AND DISPLAY CABINET.—F. R. GIDDINGS, Crosby, Wyo. The primary object of the invention is the provision of a display device, and more particularly to a display device in the nature of a popcorn



A FRONT ELEVATION OF THE DEVICE

tank by which the popcorn may be maintained in crisp and desirable condition and at the same time attractively displayed for selling purposes; the invention will effectively perform the functions above stated and will obviate the necessity of attention.

ATTACHMENT FOR CYCLORAMIC SCENERY BATTERIES.—R. C. SCHEURER and F. G. GREENBERG, address R. C. Scheurer, 508 Summit Ave., West Hoboken, N. J. This invention relates to theatrical scenery. The general object is to provide an attachment that may be applied to the back batten and side battens in such manner that when the battens with the scene attached are being raised and lowered to and from the flies, the side battens will hang pendent in the same general vertical plane as the back batten, whereby to clear adjacent scenic elements and other objects.

STREET CLEANING DEVICE.—F. M. GRADY, 520 Dakota St., Butte, Mont. The aim of this invention is to provide a street cleaning device to effect a deliverance of snow or other material cleared from the sidewalk or street by the device from one side of the device toward the curb. The angle of the scoop or implement may be varied with respect to the handle by a simple manipulation of the parts.

CALENDAR.—J. A. CHRYSANDER, 201 W. 109th St., New York, N. Y. Among the objects of this invention is to provide a device in the nature of a calendar, but which is not limited to this adaptation, and in which a plurality of memorandum spaces are provided, the leaves forming these memorandum spaces being capable of being disposed in such a manner that it is unnecessary to sever them from the pad of the calendar so that a permanent record may be kept.

MAGAZINE FOR HAND FIREARMS.—W. E. ROSEBUSH, c/o City Club, Spokane, Wash. The object of this invention is to provide a magazine arranged to insure a proper delivery of the uppermost cartridge into the barrel without danger of scraping, scarring or otherwise injuring the leader bullets. Another object is to prevent slippage or accidental forward movement of any one of the cartridges except the top cartridge, and to prevent the upward tilting of the under cartridges and scarring of the bullets.

BABY CARRIAGE.—G. H. SMITH, 23 Berkely Ave., Newport, R. I. An object of the invention is to provide a construction which the two members against relative movement of the carriage as it moves, and at the same time provide a construction which allows the rocking mechanism to be thrown out of operative engagement with the body, so that the carriage may be moved without imparting movement to the body.

ROLLER SCREEN.—J. MUGNO, JR., 13 Bergen St., Brooklyn, N. Y. It is the primary object of this invention to so construct a rolling window screen that the cross bar thereof will remain in the position in which it is released and without sagging. It is a further object to so construct a screen of this character that the roll is at all times under sufficient tension to cause the screen to stretch and be perfectly flat.

BABY ENVELOPS.—SELINA BACKMANN, 428 99th St., Brooklyn, N. Y. This invention relates to infants' wrappings, and has for an object to provide a wrapping which may be placed around a child when carrying it from one place to another. A further object is to provide a wrapping of the class indicated which will keep the infant warm in the coldest of weather.

MOVABLE CAGE.—W. W. RAY, c/o Eastern State Hospital, Lexington, Ky. The invention more particularly relates to a squirrel or mouse cage which is propelled by the occupant and caused to move in a well-defined path, an object being to provide a cage of this character which can be used as a means for advertising by placing the same in a store window or other public place.

STUDENT'S NON-ELECTRIC TELEGRAPH KEY.—D. G. WHITE, 469 5th Ave., New York, N. Y. This invention relates to a learner's telegraph key, and has for an object to provide a construction which will give a double sound on the order of a regular key while at the same time presenting a simple construction which will give the proper motion and position to the fingers and in fact to the entire hand without the necessity of using an electric current.

LIQUID DISPENSING APPARATUS.—I. LOWY, 1317 Fletcher St., Chicago, Ill. An object of the invention is to provide a device by means of which a liquid, such as a syrup or similar liquid, may be readily discharged from a glass bottle in a convenient and sanitary manner by the simple pressure of the finger against a releasing valve, means being provided for holding the dispensing mechanism in the neck of the bottle and rendering the bottle air tight.

SILVER SOLDER.—W. BOCCHETTI, 259 8th St., Brooklyn, N. Y. This invention relates to a composition for use in the soldering of silver, and has for an object the provision of a solder with a low melting point which can be used at a temperature which will not melt silver, thus avoiding warping and distortion. The composition is composed of silver 59.5%, copper 25.5%, zinc 15.0%, and one gram of arsenic trioxid to each ounce of above.

EGG CARTON.—J. M. YARNALL, 100 McLean Ave., Yonkers, N. Y. The object of this invention is to provide a construction for holding eggs in position and at the same time providing a limited amount of protection. Another object is to provide a device formed of two parts hinged together with means in each part for receiving eggs so that when the parts are hinged together there will be a double row of eggs held out of contact but within a minimum space.

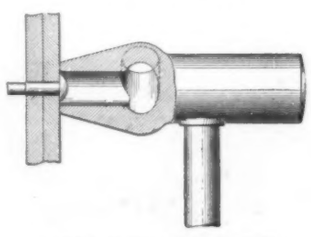
PRINTERS' QUOIN.—G. DUNCANSON, JR., 94 Randolph Ave., Jersey City, N. J. Among the primary objects of the invention is to so construct a printers' quoin that the two members constituting the quoin will be positively guided in their movements relatively to each other, and to provide means for maintaining the two members against relative movement when they have been set in operative position. The device is capable of use with chases or frames or ordinary construction.

HYDRAULIC SHIPS ARMOR.—P. J. VAN POELVOORDE, 93A Barbarossa St., Nymegen, Holland. The principal object of the invention is to provide a ship's construction including an effective armor against the explosive action of torpedoes and mines. A further and more specific object is the provision of a protective construction which will embody the presence of a water mass maintained between inner and outer walls whose relation is such that an explosion against the outer wall will have its destructive effect dissipated in this water mass.

ADVERTISING AND OTHER DEVICES.—H. K. HARRIS 96 Victoria St., Westminster, London, England. This invention refers to devices provided with a selective part or a series of such parts adapted to be brought into successive position in order to control the movement of exhibiting means in the case of advertising devices and of analogous parts which have to be set into predeterminable positions in the case of other devices.

Hardware and Tools

TOOL.—B. F. BAIRD, 323½ Allegheny St., Hollidaysburg, Pa. The invention particularly relates to a tool designed for use in connection with the removal of rivets, an object being to provide a tool which supports the plate



A VIEW IN OPERATIVE POSITION

or plates, on which the rivet is positioned, so as to prevent bending or bulging of said plates during the operation of removing the rivet, the device receiving the removed rivets and permitting the latter to fall to the floor without endangering persons.

LOCK.—A. LASKY, 110 Williston St., Bridgeport, Conn. The object of this invention is to provide a lock more especially designed for use on trunks and similar articles and arranged to prevent picking of the lock and opening the trunk by unauthorized persons. A further object is to provide a lock which is simple and durable, and therefore not liable to get easily out of order.

ADJUSTABLE CASTER.—C. W. OSTRANDER, 147 Pratt St., Winsted, Conn. This invention has for its object to provide a construction wherein the usual caster effect is secured while the wheel thereof may be raised and lowered and lockd in any adjusted position. Another object is to provide a vertically adjustable wheel for casters wherein means are provided which will permit the vertical adjustment substantially, regardless of the weight thereon.

SCREWDRIVER.—J. PEYER, 301 W. 68th St., Brooklyn, N. Y. This invention relates more particularly to a type of tool having a handle separable from the tool proper, in order to adapt the tool to the particular work at hand by reinstating within the handle a smaller or a larger driving shank or bit, chisel, punch, or various other kinds of tools.

Heating and Lighting

OIL BURNER.—K. D. OBENSHAIN, 400 Heard St., McKinney, Texas. The invention has for its object to provide an economical and easily handled burner of the character specified, having a large capacity and wherein the burner is automatically controlled by the differential pressure between the oil and steam within the burner head.

Machines and Mechanical Devices

INKING ROLLER.—A. R. COLGIN, 916 Napier Ave., Richmond Hill, L. I., N. Y. The invention relates to printing presses; its object is to provide an inking roller arranged to reduce the amount of pastic composition to a minimum. Another object is to permit of retaining the comparatively heavy spindle or stock by the printer while the lighter shell is shipped to the roller maker for replacing a worn out or defective rim by a new one, thereby saving considerable in the expense of shipping.

ATTACHMENT FOR HAT CLIPPING MACHINES.—J. S. LEIBOWITZ, 133 Clymer St., Brooklyn, N. Y. The principal object of the invention is to provide a pneumatic means in the nature of an attachment which is adapted to be associated with hat clipping machines for effecting the removal and collection of clippings therefrom; the device is in the nature of a hood having an exhaust nozzle designed to communicate with a suction hose, and is adapted to be attached to the machine without materially altering its structure.

THERAPEUTIC APPARATUS.—J. J. CARLOTTI, 80 Perry St., New York, N. Y. Among the objects of this invention are to mechanically induce circulation of the blood in the human body, to mechanically manipulate the human body, to avoid shock or injury to the body when treating the same, to regulate the extent and quality of the treatment, and to insure similarity in the treatment administered.

RATCHET CHAIN BLOCK.—W. R. BUTNER, Yerington, Nev. An object of this invention is to provide a ratchet chain block having one side thereof anchored and the movable chain operatively connected to the other side of the block, and caused to move by the oscillation of the lever imparting rotary movement to a chain sprocket wheel, and provide means for controlling the ratchet engagement of the lever with the ratchet wheels, and for preventing the chain from entangling the sprocket wheel. The device can be folded into comparatively small space when not in use.

Prime Movers and Their Accessories

ELECTRICAL VAPORIZER AND BURNER.—N. D. BELINSKI, 6133 Callowhill St., Philadelphia, Pa. The invention relates to internal combustion engines, and its object is to provide an electrical vaporizer and burner arranged to convert liquid fuel into a superheated burning vapor at the time of its passage into the working chamber of an engine cylinder. Another object is to render the engine self-starting.

Railways and Their Accessories

DUPLEX BOILER GAGE.—C. H. and W. R. JOHNSON, 477 Palisade Ave., Jersey City, N. J. The object of the invention is to provide a boiler gage for use on stationary or locomotive boilers and arranged to remain in service even in case one of the glasses should break. Another object is to allow convenient replacing of a broken glass without interrupting the use of the gage.

ROLLER BEARING CAR WHEEL.—W. B. BRIDGES, 210 East Broad, Texarkana, Ark. The object of this invention is to provide a roller bearing car wheel which is simple and durable

(*Continued on page 478*)

The Yangtse Shallow-Draft Steamer "Anning"

(*Continued from page 461*)

a hinged flap. In Fig. 2, the vessel is at shallow draft and the flap automatically takes up the best possible position for efficiency. In Fig. 3 the flap is shown with the vessel at deeper draft. In this case the flap has gone up to the top of the tunnel and the propeller efficiency is secured by taking full advantage of the increased draft of water.

A large number of vessels have been fitted with this system, including 16 small gunboats 120 feet long by 20 feet beam for the "Tigris," and 12 large gunboats 230 feet long by 36 feet beam for the "Tigris," "Danube," etc.

In navigating such rivers as the Yangtse between Ichang and Chungking the tunnel system steamer has a further advantage over the ordinary type of screw steamer, for when passing through rapids where there is broken water the propeller in the tunnel is not nearly so liable to be affected by the disturbances. This has been proved by experience gained with the "Shu-Hun," a predecessor of the "Anning," which has been run on the Yangtse since 1913 and is to this day recognized as the best steamer on that reach of the river.

Owing to the civil war along the banks of the Yangtse, in which north and south China have been engaged, a certain amount of interruption of the steamer navigation has taken place, more particularly where Chinese vessels were concerned. It is understood that conditions have somewhat improved in this respect recently, and it is expected that there will be great developments in the shipping on this reach of the river. There is no doubt but that many vessels similar to the "Anning" could be most profitably employed there.

Putting Motion Into Mechanical Drawings

(*Continued from page 464*)

job involves special apparatus in the shape of an "animating stand." The animating stand consists, first, of an angle-iron framework in the lower part of which is a broad table, at convenient working height, upon which the drawing—called a "mechanigraph" now that it is finished—is placed. The camera is carried overhead, with its lens pointing down toward the table, and is mounted on slides so that it can be moved up or down to permit covering any size of field.

The motion picture camera has two shafts for operating its shutter and film-moving mechanism. When the shaft ordinarily used is rotated, each rotation causes eight exposures to be made. The second shaft causes one exposure to be made at each revolution, and is known as the "stop-motion" shaft. This is the shaft used in making mechanigraphs. Instead, however, of being driven by hand through a crank, it is driven by a small electric motor. In photographing a job the motor is allowed to run continuously. It does not turn the shutter shaft, however, unless a trip is operated by hand or by foot. When the trip is operated a positive clutch engages the shutter shaft, gives it one turn and makes one exposure, and then automatically disengages, the motor running idle until the trip is again operated. Needless to say the clutch is so adjusted that when idle the shutter is closed.

The mechanigraph is placed on the table and adjusted as to position so that it is in proper relation to the field of the lens, the camera's height is adjusted so that all or as much as may be desired of the drawing is in the field, the lens is focused, the stop or opening set, and the camera loaded with film and closed. With everything ready for work the lights are turned on. These are mercury-vapor lamps suspended adjustably on each side of the table, so that the field is brilliantly and evenly illuminated by the greenish glow.

In the case of the vacuum fuel-feed system, the picture is started by showing the exterior of the apparatus. There is no motion to be registered, so the trip is held in the operating position and the camera shaft is turned continuously until a sufficient length of film has been exposed. Then the exterior parts are "dissolved out." The most effective way of doing this is to use a "cross dissolve." By pressing a button on the camera a mechanism is engaged which gradually closes the shutter while the motor rotates the camera shaft. The result is that the light admitted through the lens is decreased slightly in each successive exposure until finally the shutter is completely closed and no light enters. If this film were developed the result would be a gradual fading of the picture until it would disappear completely.

At this point the drawings representing exteriors, which have been temporarily laid over the sectional drawings, are removed, bringing the working parts into view. Then with the shutter closed the film is run back to the exact point where the "fade" was commenced. The motor is then run forward and the fade is repeated, going over the same film as before—with one important difference. Where the shutter, on the "fade-out," began to close it now begins to open, and when the point is reached where the shutter was completely closed on the fade-out, it is wide open on the fade-in. This is called a "cross dissolve" or an "overlap dissolve." On the screen, the result is that the exterior view dissolves—there is not a better word—into the interior.

A few feet of film are then run through showing the working parts stationary, after which the real work of the "animator" begins. The parts must be photographed in such a way as to show their movement. They cannot, however, be moved and photographed while they are moving, as in the familiar process of "straight" motion picture work. The parts are moved by hand a small fraction of an inch. Then the trip is operated and the motor causes the camera to make a single exposure. In motion picture parlance, one "frame" is exposed. Then the parts are moved another fraction of an inch and another exposure is made, and so on—a little movement and one exposure, another movement and another exposure, still another and another until the parts have completed a movement, or a series of movements. All movements must be equal when a steady motion is required; otherwise there will be a jump on the screen. In the case of the subject in question the movements were each about a thirty-second of an inch.

A curious feature of this work is that it is not really motion picture photography at all. It is simply a series of "still" photographs showing a succession of different positions of the object photographed. On the screen, however, the illusion of movement is perfect. Even if the animator, through an error of judgment, moves the parts too far at each exposure, the projected picture still maintains the illusion of motion rather than a succession of "stills," but the motion will be a series of very rapid jerks or jumps.

One of the difficulties of mechanical animation becomes evident when there are several parts to be moved and it is impracticable so to connect them that they will move together. They must be moved separately, and the movements must be so gaged that the proper relative positions will always exist. Usually this involves a schedule, prepared after all the movements have been exactly calculated and tabulated.

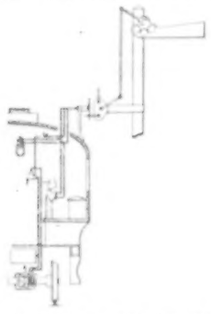
There is a good deal more to be done, however, before the work is finished. The object sought is not merely to show how

RECENTLY PATENTED INVENTIONS

(*Continued from page 476*)

in construction, composed of comparatively few parts and arranged to permit of easily making repairs without requiring removal of the axle from the car. This invention permits the use of a stationary axle or similar support, hence axle journals and bearings as now generally constructed may be dispensed with.

AUTOMATIC TRAIN CONTROL.— E. H. CHABOT, 23 Temple St., Nashua, N. H. This invention relates to means for automatically stopping trains if for any reason the engineer fails to observe the signals which are set against him. The device has for its object



A DIAGRAMMATIC VIEW SHOWING THE SIGNAL MECHANISM

to provide simple and effective means whereby it is impossible for a train to pass a signal that is set to stop or caution position without having the controlling mechanism operate to shut off the steam or apply the air brake, or both, to bring the train to a stop..

Pertaining to Recreation

TOY.—E. C. RICHARDSON, 8 Pershing Court, Ridgefield Park, N. J. Among the objects of the invention is to provide a toy of the nature of what is commonly known as a "see-saw." A further object is the construction of a certain operating provision by means of which the see-saw may be moved, and which will further serve as a grip whereby the children may grasp the see-saw so that danger of their falling off is reduced to a minimum.

Pertaining to Vehicles

VEHICLE WHEEL.—M. BENS, Box 2, South Chicago, Ill. An object of the invention is to provide a vehicle wheel having means in itself for absorbing and dissipating the shocks and jars. A further object is the provision of a device in which a solid tire is engaged by a pair of outer rim members and a pneumatic tube is arranged between the solid tire and the hub, thereby safe-guarding the pneumatic tube from puncture without lessening the resiliency of the wheel.

DEVICE FOR CONTROLLING FROM A DISTANCE THE WINDOWS OF MOTOR CARS AND OTHER VEHICLES.—P. SEURIN, 84 Rue Lauriston, Paris, France. This invention relates to an air pressure device for controlling or operating from a distance the windows or glass panes of doors, front frames and partitions of motor cars, which device can be used for controlling the movable windows of vehicles such as motor buses, railway cars and the like.

GAS ENGINE CUT-OUT MUFFLER.—H. M. WRIGHT, Jr., 144 W. Newell Ave., Rutherford, N. J. An object of the invention is to provide a gas engine cut-out fitted with a double cut-out means such as a motorcycle or automobile engine cut-out and muffler, which may readily be attached to a motorcycle or other internal combustion motor vehicle and which may be installed to replace the ordinary type of muffler usually employed.

TRUCK.—F. E. CARTER, Box 165, Yuma, Colo. The invention relates more particularly to a truck for handling the wheels of heavy motor vehicles. The object is to provide a truck which may be easily positioned to receive the wheel, and which may be adjusted to accommodate various size wheels, and may be positively set or locked in engagement with the wheel to thereby support and carry the same.

ANTISKID DEVICE.—J. R. BAUDE, 2705 Jackson Blvd., Chicago, Ill. Among the objects of the invention is to provide a form of antiskid device that can be quickly attached to the rim of a wheel whereby skidding forwardly, backwardly and laterally will be prevented. A further object is to provide such a device as can be attached or detached without the use of any tools; the device takes up little room in transportation.

PNEUMATIC JACK AND PUMP.—C. STEPHENS, Rosendale, Mo. The particular object of the invention is to provide a device adapted for use with automobiles. Another object is to provide a device in which the pump may be used to supply fluid pressure to the jack or by a single manipulation may be adapted for use as a pump for inflating a tire or for general purposes.

TIRE CASING.—C. W. MIEGEL, 323 Lambeck Ave., Jersey City, N. J. This invention has for its object to provide a casing especially adapted to be proof against blow-outs, rim cuts, and side wall breaks, and to add resiliency to the tire. In case of a puncture of the outer portion of this tire the inner portion will immediately reinforce the outer portion.

LENS FOR HEADLIGHTS. — L. and H. BENZER, 141 Roebling St., Brooklyn, N. Y. The invention relates to lenses for projectors, and it pertains more particularly to lenses adapted for use in connection with headlights of motor vehicles. It is the primary object to increase the intensity of the side or "ditch lights," this result being obtained by the transversely concave surfaces of the lens.

WHEEL.—G. YATES, 3215 Carnegie Ave., Cleveland, Ohio. This invention has for its object to provide a wheel construction wherein roller bearings are arranged between the wheels and the journal box, the wheels being rigidly connected. With this construction the housing ring may be removed, and the rollers also removed without taking the wheel off the axle.

NEW BOOKS, ETC.

EMINENT CHEMISTS OF OUR TIME. By Benjamin Harrow, Ph.D. New York: D. Van Nostrand Company, 1920. 8vo.; 248 pp.; 21 illustrations.

As Dr. Harrow says, the pioneers in chemistry have inspired a few biographers, but our modern chemists are largely ignored by permanent literature. Hence this popular volume of life-stories dealing with Perkin and his coal-tar dyes, Mendeléef and the periodic law, Remsen and the rise of chemistry in America, and eight other eminent moderns whose claim to attention is indisputable. The high lights of their careers are picked out with precision, their discoveries are carried forward into present-day development and practice in a most interesting way, and a rich gallery of portraits enables us to meet these notables, as it were, face to face.

PELOUBET'S SELECT NOTES ON THE INTERNATIONAL UNIFORM SUNDAY SCHOOL LESSONS FOR 1921. By F. N. Peloubet and Amos R. Wells. Boston: W. A. Wilde Company. 8vo.; illustrated.

Each year more and more Bible students recognize the inspiration and almost indispensable help to be derived from this commentary, with its suggestions to teachers, its judicious treatment of doctrinal questions, its fresh viewpoints, and its maps and illustrations. Its selection and arrangement of material and the manner in which it spurs and sustains the interest speak volumes for the ability of the compilers.

PATENT LAW. By John Barker Waite. Princeton, N. J.: Princeton University Press, 1920. 8vo.; 316 pp.

Professional men and men of business often find it necessary to ascertain their rights in respect to inventions and patents. Professor Waite's new text-book covers the substantive law of patents, their nature, validity and effect, and their characteristics as property. He has canvassed every issue passed upon by the courts, and his work discloses a close-knit structure of facts and interpretations that the layman, as distinguished from the patent practitioner, will find exceedingly helpful.

the parts move, but rather to create a picture showing the effects caused by these movements as well. In the present instance this involves showing the flow of gasoline from the main tank to the vacuum tank, through the valves, from the upper to the lower tank and out to the carburetor. The principle used in creating the illusion of the rising or falling of liquid in a tank, or its flow through a pipe, is simple and can be applied in a number of ways. In the case of a tank, a piece of transparent celluloid is cut that will fit in the tank drawing, and provision is made for moving it up and down while showing only that portion which should properly be shown in the tank; the exact method will depend upon the nature of the job. On the celluloid lines are drawn, much as in drawing the conventional water of the drawing-board. When this is moved and photographed as described, the lines are "lost" on the screen and there is left the illusion of movement of a transparent body. By using celluloid the tank can still be seen through the liquid, making the illusion so much more complete. Other equally simple tricks are employed to show the liquid falling in a broken stream and splashing foamily into the tank.

Part of the animator's stock in trade consists of unlimited patience. Such a picture as that of the vacuum fuel-feed will run about 400 feet. With sixteen frames per foot, this means a total of 6,400 frames. Some of these are run off rapidly under the camera, where there is no motion to be shown. There remain, however, about 5,000 frames that must be exposed individually, each after a careful setting of a number of parts. Small wonder, then, that the making of a film that will show on the screen for three or four minutes may involve anywhere from two days to two weeks of work under the animating camera—to say nothing of the time required for the preparation of the mechanigraphs by the draughtsmen and artists.

There are cases where it is necessary to show movement that cannot be simulated by the methods already referred to. For instance, suppose it is desired to make a mechanigraph of a power-driven tire pump, such as is used in automobiles. In order to get the whole pump in section at the same time it is necessary to draw it in the plane of the crankshaft. This gives an edgewise view of the gears and crank; yet their motion must be shown. In the case of the gears the "three-position" trick, well known to animators, is used. A drawing of the gear is made with the teeth carefully placed and spaced. Then a second is made precisely similar, but showing the teeth advanced through a distance equal to one-fourth of a tooth and a space, and a third shows a similar advance over the second. The first gear is laid in position and photographed—a single frame. Then the second, and then the third. Then the first is laid down again, and the second and third, and so on, for as many feet of film as may be necessary. If the drawing has been properly done the projected picture will show perfect motion. The person who is informed on the subject of motion pictures will recognize at once the connection between this procedure and the various illusions which are encountered in photographing the wheels of a moving vehicle.

The crank has to be handled differently, for it changes its appearance as well as its apparent length with every move throughout its swing. A separate drawing is made for every position of the crank, and cut out. The cut-outs are laid down one at a time and photographed, the piston and connecting-rod positions being changed each time the crank is changed. When the connecting rod moves back—that is, away from the spectator—it naturally goes into the shadow of the cylinder and crankcase. So a separate piece, precisely like the connecting rod but darker, is laid on when the rod is in the shadow. This gives the impression that the rod swings back and forth, when in reality it simply moves straight up and down.

There are innumerable other tricks and devices that are called into play by the mechanical animator, and many pieces of special apparatus are devised to attain specific results. Many of these ideas are more or less jealously guarded as "trade secrets," but the truth is that once a picture is shown on the screen, a good animator can figure out pretty accurately how it was made, and can generally do the same thing himself. There are few set rules and processes in the type of mechanical animation described. Every job brings its own individual problems, and solving them involves ever new schemes and tricks—it is just one little invention after another. But this very fact makes the work more than fascinating in spite of its difficulties, and the greatest reward an animator can ask is a perfect picture on the screen. This brings with it a thrill even beyond that of the author who sees his work in type for the first time.

Counting Electrons

(*Continued from page 465*)

tral, but has a positive charge of one or two or more electronic units, according as one or two or more electrons have been detached by the passage of the alpha rays through it. If then this atom is just underneath the drop of oil, it is thrown instantly by the electric field into the latter; and then if you are observing you see something interesting.

Suppose you look through a telescope with a scale fixed in the eyepiece? The drop of oil shows up like a very minute star on a dark background. You wait a few seconds after turning the lever which exposes the gas to the alpha rays. Bing! You have bagged an electron, or possibly two. These are the positive electrons of the nucleus of the atom whose negative satellites were knocked off by the alpha ray. Instantly the atom, carrying now its extra positive electron or electrons, strikes the oil drop. The drop begins to move up—very slowly and regularly, for the laws that govern falling bodies are suspended in the case of minute droplets in a gas, and the speed of the oil drop remains constant. From the rapidity with which it moves you can see at once whether you have caught one or two electrons, for in the latter case the drop will move just twice as fast as in the former one.

In his lecture on the structure of the atom Sir Oliver Lodge has stated that we may well fear future wars if the terrible secret of how to utilize the energy contained in the atom falls into the hands of an uncivilized power. Not only human life, but the whole planet, could be destroyed, he asserts. Radium discharges alpha particles with sufficient force to carry them around the world in a fraction of a second—at a velocity that is really only a little bit slower than that of light. This power is dormant in each atom; if we ever learn how to release and control it for our own purposes the fuel shortage will mean nothing at all in our lives, and the invention of ways for making synthetic gasoline out of water plus a mysterious green powder at a cost of a cent and a half a gallon will go wholly out of vogue, because such fuels will be ruinously expensive alongside the atomic source of energy.

A Steam Locomotive as a Punch-Press

(*Continued from page 467*)

drilling machine driven by compressed air, suspended from a jib and maintained at the right level by a counterweight. The cup cooling was so devised as not to waterharden the metal; it merely imparted to it sufficient resistance to prevent the punch from driving through the base of

the cup. While the cup was being made ready, the man in charge of the punching inserted the first die, duly greased; his assistant then placed the base of the cup in the die, the regulator valve was opened and the punch drove the cup through the die. As soon as the forging had been driven through, the die, which in the process had been raised and placed exactly in the axis of the cylinder, fell back in its seating and constituted a stop which helped to strip the forging from the punch as the piston traveled backward. The forging then fell on a gutter plate, whence it was removed and replaced on the punch when the piston was in the rear position.

During the time occupied in this the man in charge of the punching operations replaced the first die by a smaller second one, when the drawing down continued in practically the same way, the second die acting also for stripping the forging from the punch. The third pass proceeded in a similar manner, but before this, the forging was slightly reheated. During the drawing-down operations, the punch was cooled by water jets and the dies were freed of scale, cleaned, greased and placed in order for each successive operation.

Besides the regulator-valve handle, the engine driver had within easy reach an air-brake valve which was used to brake the driving wheels at the end of each revolution and to stop the crank on the rear dead-center. As soon as the forging had been driven through the die, and although the regulator-valve was immediately closed, the inertia of the driving wheels frequently resulted in two or three revolutions at comparatively high speed before the piston could be stopped at the back end of its travel. This resulted in somewhat heavy jerks which shook the wheel scotches; it sufficed, however, to inspect the position of the scotches every morning and to strengthen them where this was found to be necessary.

The installation ran successfully for about two years and produced several hundred thousands of 75 millimeter shells, pending the putting down of a more suitable hydraulic plant. It enabled the works, from the very commencement of the war, to do away with the manufacture of shells by boring out of the solid, thus saving a large quantity of metal, and much time and making the machine tools which would thus have been utilized available for other pressing munitions work.

An Alternative to Einstein

(*Continued from page 468*)

earth exactly; for that of Mars within 0.08 per cent. Corresponding figures for Einstein as his theories are superposed upon ordinary astronomical practice are 0.2, 37.5, 0.2 and 0.4 per cent. In the cases of the inclinations of Mercury, Venus and Mars Dr. Poor has discrepancies of 0.15, 1.8 and 5.3 per cent, while Einstein's discordances inherited from older theory are 5.3, 9.8 and 0.4 per cent. In the matter of the nodes Dr. Poor's debts to observation amount to 0.04, 0.06 and 0.15 per cent, and Einstein's inherited difficulties come to 6.8, 0.6 and zero per cent. We may remind the lay astronomer that the earth has no inclination and no nodes because it is always in its own orbit, whose plane measures these items in the other planets.

Dr. Poor has the advantage in eight cases out of ten; if we try to weight his advantage by the usual method of least squares, he has the better of the argument on a basis of about 30 to 1. Controversially it might be maintained that he has given the Einstein theory a fair run, since the results attained by it and quoted in the above discussion are stated by its proponents as ground for accepting it. As a matter of fact, however, Dr. Poor's own system is simply the Newtonian system, allowed the benefit of greater exactness than it has ever before enjoyed. For a fair comparison, we must of course allow Einstein the same benefit. If we go independently through the operation of determining the characteristics which the solar envelope would have to possess in order best to reconcile calculation under the Einstein law of gravitation with the observed facts, we arrive of course at a different distribution of the zodiacal material, but one equally in accord with physical possibilities; and if this distribution be realized, Einstein's discrepancies are greatly reduced, but are still greater than those of the Newtonian theory as reinforced by Dr. Poor. In place of a thirty to one comparison, there is now a preference of three or four to one in favor of Dr. Poor according to the least square verdict.

For the benefit of the layman who does not realize as clearly as he might just what the scientist means by an assumption, it ought to be emphasized that Dr. Poor does not present these calculations as proof or even as evidence that the material of the solar envelope is arranged thus and so. He might with some show of provocation make this claim, in view of the fact that Einstein's hypotheses are often held by his followers to be proved by the verification of one or two of their consequences; but he carefully refrains from any such unjustifiable claims. His whole purpose is merely to prove that Einstein's assumptions are not necessary to account for the behavior of the planets. He proves this by showing that if instead of assuming the things that Einstein assumes, we assume something else, the observed facts are accounted for as well as by Einstein's postulates, if not actually better. *If* the zodiacal matter is arranged as Dr. Poor suggests, Einstein's theory is superfluous and in fact hardly tenable. That is all Dr. Poor has attempted to show, unless we make some reservation in connection with his efforts to point out that the arrangement which he discusses is entirely a possible one and in full accordance with what little we know of the distribution of the circumsolar matter.

In the present state of knowledge, then, we must say that the planetary motions do not furnish a definite test of the validity of Einstein's hypothesis or of Dr. Poor's hypothesis. It becomes a problem of observational astronomy to push investigation to the point where one or the other of them may be disproved. Until then, the proponent of either system may say that it fills the bill with an accuracy that satisfies him, that its assumptions appear to him to be reasonable, and that its subsidiary features are such as to make it appeal to him more strongly than the other—but he may go no further than this so far as the evidence of the planetary motions is concerned. The writer believes that the subsidiary features of Einstein's theory weigh so heavily in its favor as to leave little choice; but that is only an opinion. Such opinion, or even a universal consensus in the same direction, would not be competent to eliminate Dr. Poor's suggestion, which can be disqualified only by direct observational evidence disproving one of its assumptions or one of its consequences.

New Sources of Pulp and Paper

(*Continued from page 469*)

the bamboo and other plants named.

In reeds and grasses the cellulose membranes are less permeated with lignin and a smaller quantity of alkali is consequently required for their reduction to paper pulp than is the case with woods or plants of solider stems. In Germany, Czechoslovakia, and Roumania, the stalk, sheaths and leaves of Phragmites and Typha have been used for the preparation of cellulose with satisfactory results. The root stock of Phragmites is made to yield alcohol before being pulped.

The reeds used in this country for the manufacture of floor mats, etc., might prove a good source of paper pulp, and

the waste from mat factories might also be experimented with. The dried plants are best adapted for use, since the green material contains coloring matter which makes bleaching difficult and expensive. Before harvesting the plant it should be allowed to stand from the actual time of ripening until winter sets in. This permits a more thorough drying and the mechanical action of air and cold favors the rupturing and weathering of all the cell constituents. The stalk and sheaths of the plants are considered the most suitable materials for pulp on account of their higher yield of cellulose fibers, amounting to between 30 and 35 per cent.

The cells of which the fibers of reeds and grasses are composed are short, rather wide in proportion to their length, and thin-walled. While these characteristics render the fibers unsuitable for conversion into the finer grades of bond and writing papers, they facilitate and cheapen the production of the pulp for purposes for which it is suitable.

It is not an idle dream to look forward to a time when pulp and paper manufacturers will have abandoned their present methods of obtaining cellulose fibers and treat paper pulp as a by-product of manufacture rather than a main product. From the tree or plant a whole range of valuable organic derivatives might be first extracted, leaving the cellulose, cell walls or skeleton of the plant to be utilized last of all. It is the tendency of modern methods of manufacture to proceed in this way, but it must be confessed that it is a far glance into the future where the paper industry is concerned.

As has been pointed out by Steinmetz, it is not so long since the coal tar produced in coke ovens was thrown away as a useless waste material. In the manufacture of sulfite pulp, the waste liquor of the cooking process is regarded similarly and the great bulk of it is washed into rivers and water courses to their pollution, only a small quantity of the available material being utilized as roadbinders, or for cementing foundry cores, and still less as a source of alcohol after fermenting the sugars contained in it. May it not be, that like the former waste product, coal tar, sulfite waste liquor may yet be made to yield many valuable organic chemical substances and evolve a new and profitable industry?

Sixty Tons Per Minute

(*Continued from page 470*)

trimmer device has maximum dimensions of 7½ by 9 5/6 feet. It will go into pretty much any hatch larger than 8 feet 11 inches. The trimmers are electrically operated. They are a product of the designing ability serving the railroad.

Some may think the throw of the trimmer very likely to break up the coal. It should be remembered, however, that the most of the throwing is done in directions not greatly different from the horizontal. In other words, the coal may be thrown a fair distance horizontally, but drop only a short distance vertically. It is the drop that is mostly responsible for breakage. In fact, the operation of the trimmer is a good deal like that of a man throwing coal with a shovel. Only, in this case, the shoveler is a giant of a fellow.

The great pier is a notable affair of concrete and steel. It is built low and by this style of construction avoids the excessive cost incident to the building of great tall steel structures like those at Hampton Roads. On the other hand, there is perhaps a greater amount of power-driven apparatus connected with the Baltimore pier. The capacity is reckoned at 12,000,000 tons per annum—that is, about half the tonnage transferred from rail to ship either at New York Harbor or at the harbor of Cardiff, Wales. It is understood that, if this pier were now to be constructed, the cost would be double the $2,500,000 actually expended.

Valuable Binder Material from Waste

(*Continued from page 471*)

tons capacity each without incineration or objectionable odors or fumes. Any tonnage of garbage can be handled according to this arrangement, and within a period of eight hours the entire volume of refuse can be disposed of without cooking. This is a great improvement on the many methods of garbage disposal now in use.

The incineration system of handling municipal wastes of this description always was very expensive and generally unsatisfactory. The reduction method which features special treatment to obtain the oils and fertilizing materials contained in the garbage is also very costly and generally is maintained at a loss in cities which follow this plan. The practice of feeding garbage to hogs is yet in an experimental stage and is not adapted for general practice due to the variation of local conditions in different cities. These facts all combine to endorse the new method of garbage disposal now opened up. Of course under actual operation, this method also may develop weak points but, at present, it looks like the prize method of the lot.

Cardboard treated with this binder and then placed in boiling water for two hours has been used as a container for oil without any signs of leakage for over ten months. Some of the coarser cotton clothes which have been treated with this adhesive have withstood the wear and tear of emery wheel tests under laboratory conditions which would mean rack and ruin to similar cotton clothes before being treated. Cement sacks have been made and tested thoroughly which not only are water- and moisture-proof, but which also are more durable than the bags of this kind now in use. It costs only six to seven cents a hundred pounds to waterproof ordinary paper with this substance. Paper and fabrics treated with it not only resist water and acid penetration but also are proof against the entrance of oil or chemicals. In one corner of the Mohler testing laboratory are three concrete tanks which were treated on the interior. They have been filled with crude oil, kerosene and gasoline, respectively, for the last ten months and as yet there are no evidences that any of these materials have actually penetrated the cement walls.

The Current Scientific American Monthly

(*Continued from page 473*)

artificial pearls. The "orient essence" used for coating glass beads was taken from certain fish caught in French and Russian waters. When this supply was cut short by the war, American manufacturers besought the aid of the Bureau of Fisheries which discovered that the scales of the shad and the sea herring were capable of furnishing as choice an essence as those of imported fish, and now artificial pearls are being made from a product of American waters.

"Warming Buildings with Refrigerating Plants" is the title of an article by Robertson Mathews of Cornell University, in which he shows how our vast natural supply of low temperature may be utilized.

In view of the coming attempt to scale the heights of Mt. Everest, special interest is attached to the article on "Mountain Craft," which goes into considerable detail in explaining the regimen, walking manners and equipment for mountain climbing.

In addition to the over score of articles and numerous notes, the June number contains the usual departments, giving the latest progress in science and various branches of technology.

Talking in Thousandths of an Inch

In the tools of a modern factory, and in laboratory experiments, the "splitting of hairs" has come down literally to make the thousandth part of an inch a known quantity in measurement; a work, incidentally, in which precision and accuracy are the main issues.

Whenever it is a question of precise information, you naturally consult an engineer or some technical book—in any event, you turn to an authority for the information. Now consider the Scientific American from the standpoint of authority.

Throughout all the great engineering, industrial and mechanical developments that have borne important relation to the national life of America and the advance of science the world over, the Scientific American has been active in the analysis, criticism and construction of plans and specifications that would bring success to the project.

A vehicular tunnel is proposed to relieve congestion on the Hudson River ferries. Engineers and architects are consulted, and plans drawn up; and the editors of Scientific American give immediate attention to expert analysis and investigation of the plans, giving its readers the authentic on-the-spot explanation.

Striking example of this is to be found in last week's issue of Scientific American. The Hudson River Bridge project represents the greatest constructive engineering feat ever attempted as far as bridge building is concerned. The article is called "A Study in Magnitude."

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